Western Engineering

VOL. 3 SAN FRANCISCO, AUGUST, 1913 NO. 2

PUBLISHED MONTHLY BY THE WESTERN ENGINEERING PUBLISHING CO. AT 420 MARKET STREET, SAN FRANCISCO.

Entered as second-class matter, June 1, 1912, at the post-office at San Francisco, California, under Act of March 3, 1879

Telephone Kearny 4777. Cable Address: Pertusola. Code: Bedford McNeill (2 editions).

BRANCH OFFICES:

CHICAGO—734 Monadnock Building. NEW YORK—Woolworth Building.
LONDON—The Mining Magazine, 819 Salisbury House, E.C.

ANNUAL SUBSCRIPTION:

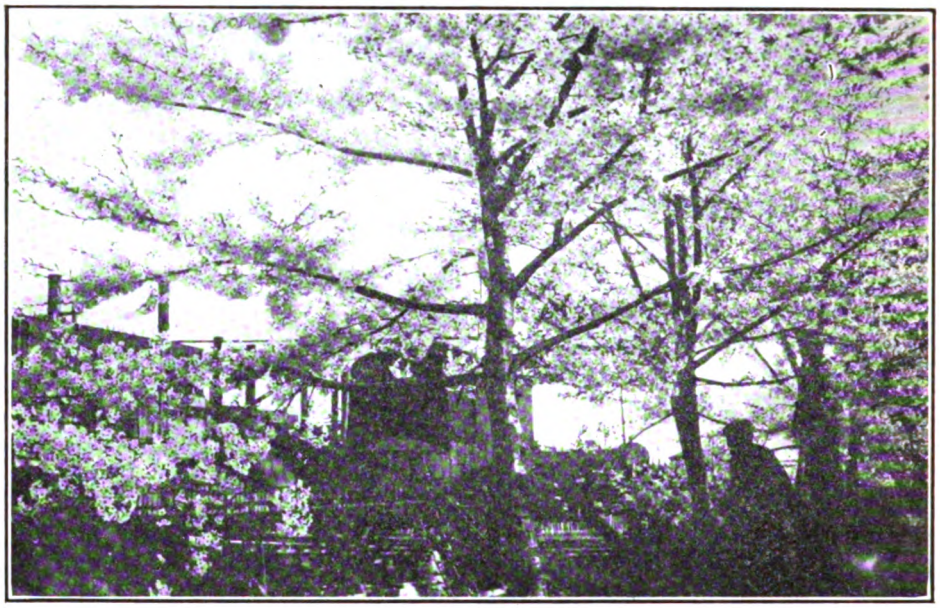
United States and Possessions, and Mexico $3
Other Countries in Postal Union 4

CHARLES T. HUTCHINSON, Editor L. A. GREENE, Business Manager H. L. QUIGLEY, Advertising Manager

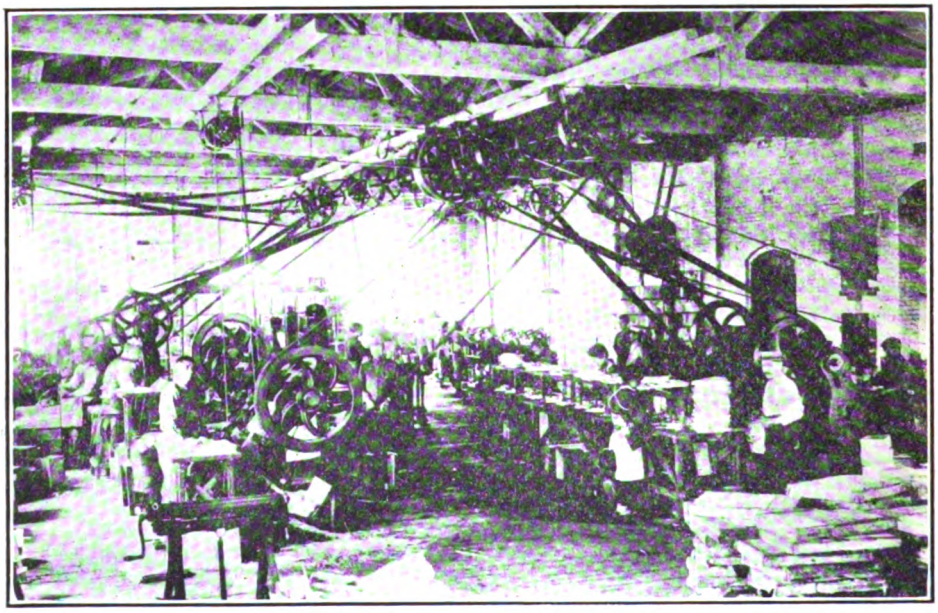
TABLE OF CONTENTS

EDITORIAL: Page.
Notes 85
Asphalt Obtained from Oil 86
The Power Companies and Irrigation 87
REVIEW OF THE MONTH 89
ARTICLES:
California Oil-Well Drilling Practice ..... *B. K. Stroud* 93
Irrigation Project of the Sacramento Valley Irrigation Company .. *R. A. Balzari* 106
The Trona Railway ..... *Raymond Ashton* 112
Concrete Socket Piling ..... *K. D. MacLean* 117
Centrifugal Pumps for Irrigation ..... *C. F. Braun* 124
THE ENGINEERING DIGEST:
Three-Two Method of Rope Splicing ..... *Alex. Wilson* 139
Seattle Light and Power Plants 140
Energy Density ..... *Charles P. Steinmetz* 141
Progress of the California State Highway 142
Transformer Capacity and Connections for Induction-Motor Feeder-Circuits ..... *J. L. Moon* 146
Australian Railways 148
Standard Measuring Weir, Canadian Pacific Irrigation Tract 149
ENGINEERS' NOTE BOOK 150
COMPANY REPORTS 151
BOOK REVIEWS 152
HINTS ON PRACTICE 153
INDUSTRIAL PROGRESS:
Sewer Repair by Means of Corrugated Culvert Pipe 154
ENGINEERING NEWS 155
DISCUSSION 163
PERSONAL 164

Generated on 2024-09-30 00:24 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



KASHIWAZAKI OIL REFINERY SURROUNDED BY CHERRY TREES IN BLOSSOM.



INTERIOR OF CAN FACTORY, KASHIWAZAKI OIL REFINERY.

Generated on 2024-09-30 00:22 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

EDITORIAL

WHY should a great news-gathering bureau waste its readers' time by publishing trivial and useless facts? We learn, for instance, through a 'special dispatch' appearing in a San Francisco daily paper that Mr. Vincent Astor has been bitten by a monkey. We may next expect to learn that the monkey is resting easily.

HORSES as a means of locomotion in California still have a little the better of it over their arch enemy, gasoline. A traffic census taken in San Joaquin county covering a period of seven days, discloses the fact that of a total of 243 vehicles, 54.2 per cent were horse-drawn and 45.8 per cent were motors.

CALIFORNIA farmers have an opportunity to participate in the advantage of coöperative effort. In order to further the work of carrying on the Big Valley reclamation project, Mr. Franklin K. Lane, Secretary of the Interior, has agreed to contribute $40,000 for the purpose of making a survey of the work projected in Lassen and Modoc counties, provided the people in the affected districts contribute a like amount.

STEPS are being taken by the Oil Protective Association of Kern county to reorganize upon a new basis. The Sutherland oil-land protective measure having failed to receive the approval of the Governor, the public-spirited men who initiated the movement are going to continue the work as best they can on a coöperative basis. The oil lands are too great an asset to the state to be subject to injury and possible destruction due to unskillful production methods, even though the importance of this fact does not seem to have made an impression on the state's chief executive.

UNUSUAL interest is attached to the announcement of the annual convention of the American Mining Congress at Philadelphia during the week of October 20. Rescue and first-aid apparatus and safety appliances are to be placed on exhibition, and should result in increased interest being taken in the 'Safety First' movement that is already well under way among American industries.

PETROLEUM production in the United States has shown an increase of over 2,000,000 barrels in 1912, according to the United States Geological Survey. Higher prices were the rule except in California, where, however, no appreciable decline took place. It is interesting to note that, of a total production of 222,538,604 barrels, California ranked first with 86,450,767 barrels, Oklahoma second with 51,852,457 barrels, Illinois third with 28,601,308 barrels, while Pennsylvania produced but 7,837,948 barrels.

OIL production is regarded as a utilitarian occupation that does not lend itself readily to artistic surroundings. That this does not necessarily follow is illustrated by the frontispiece in this issue showing the refinery of the Nippon Oil Company at Kashiwazaki, Echigo, Japan. Oil refining in the midst of a cherry orchard will ap-

Generated on 2024-09-30 00:21 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

pear somewhat novel to the dweller in the Kern county fields, to whom sagebrush is the nearest approach to arboreal beauty obtainable. We are indebted to Messrs. Ito, Sugimoto, and Matsuzawa, through whose courtesy the views shown were obtained.

THROUGH the passage by Congress of the Newlands bill, amending the Erdman act, a long step in advance has been made toward settling disputes between employer and employee. Strikes are a calamity, and the invocation of might rather than right as a means of winning a cause will, we hope, soon become a thing of the past. The new bill establishes a United States Board of Mediation and Conciliation, consisting of a Federal Commissioner of Mediation and Conciliation and two other Government officials, appointed by the President. This Board may be appealed to by either party to a railroad labor dispute. Failing to effect a settlement otherwise, the Board may endeavor to induce both parties to submit their case to arbitration, in which case special boards of three to six mediators are to be chosen by the railroads and their employees. The passage of this bill was hastened by the threatened strike of 80,000 conductors and trainmen on Eastern roads, and as both parties have agreed to submit their claims to arbitration, the strike has been averted. This act is not a one-sided affair, however. Demands for changes in the relations between employer and employee generally proceed from the men, but under the Newlands act the railroads also are privileged to ask for the services of an arbitration board. A disagreement has arisen between the Southern Pacific Company and its employees concerning the extension of the right of interchange to the electric lines. Nearly 5000 men voted to go on a strike if their demands were not granted and thus tie up all of this Company's system west of Ogden and south of Portland. Appeal has been made by the Company to the Government under the Newlands act, and it is hoped that a strike may be averted.

Asphalt Obtained From Oil

Until recently the popular idea of asphalt represented the solid material found in certain veins in Utah, or obtained from the shores of the Dead Sea, or from the asphalt lake in the Island of Trinidad. Within the past few years, however, the asphalt trade has been dominated to a steadily increasing extent by a different variety of asphalt obtained by boiling down the heavy petroleum found in California and in the region of the Gulf of Mexico to a semi-solid material which has found wide use for roofing purposes and as a binder in modern road construction. A total of 333,213 short tons of this oil asphalt was made in 1912 and had a value at the points of production of $3,534,077. This is a gain of 33.7 per cent over 1911, and is nearly three times as much as the output of all other kinds of asphalt taken together, as shown in the annual report by David T. Day, of the United States Geological Survey, published as an advance chapter from 'Mineral Resources for 1912.' Asphaltic oils differ widely in the proportion of asphalt contained, ranging from oils having no asphalt to very viscous oils suitable for road material with practically no refining. Such natural liquid asphalt is known in many localities, especially near Lander, Wyoming. It has not yet come into popular use, as asphaltic residues of ex-

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

actly the required consistence may be obtained more cheaply by boiling down the thinner asphaltic oils characteristic of many regions in Texas, California, and Mexico. The proportion of asphalt contained in the asphaltic oils of California, Texas, and Oklahoma varies within wide limits. The oils of the Coalinga district, California, vary from 1.89 to 57.42 per cent. In the Kern River field there is a variation between 16.2 and 38.7 per cent. In the Sunset-Midway-McKittrick region, the variation ranges from 11 to 51 per cent, in the Los Angeles field from 13.3 to 42.2 per cent, and in the Santa Maria field from 12 to 42 per cent. It is evident from the figures of production of asphalt in California that the industry is expanding rapidly. This expansion is easy, because of the practically unlimited amount of asphalt which can be separated from the crude oils, especially from the heavier grades. During the latter part of 1912 the Standard Oil Company of California ceased making contracts for crude petroleum below 18 degrees Baumé. This forced the producers to 'top' their product, obtaining large amounts of asphaltic residues. These they sold partly for fuel and partly for asphalt. The heavy oils of the Kern River field required comparatively slight topping to leave an asphaltic residue which was well suited for road and roofing asphalt. Under the conditions it has proved possible to push the sale of California asphalt to great distances. In fact, early in 1913 the American ship *Manga Reva* sailed for New York with a cargo of 3500 tons of California oil asphalt in open-headed barrels. This was her second voyage with such a cargo. The trade thus begun is expected to increase greatly on the opening of the Panama canal.

The Power Companies and Irrigation

It is a matter of general knowledge that the development of hydro-electric power in California has been exceptionally great. To what extent this development is entering into our daily lives is hardly appreciated. That the greatest use for electric power is centred in the large cities and towns is an erroneous idea. On the contrary, outside of the lighting load, the rural districts, and especially the farming sections, are already large consumers of power. The development of intensive farming, with a consequent demand for irrigating water, is largely responsible for this condition. From the standpoint of the power companies, this is a most desirable business. As it is, or should be, entirely day load, and draw from the source of supply when the load is off peak, it improves the load factor and materially adds to the companies' revenue. This great increase in electric pumping for irrigation purposes, especially when the water is pumped from underground sources of supply, has brought about a new set of conditions that merits serious attention. The farmer generally has gone about his pumping as if the supply of underground water was both permanent and inexhaustible. The old proverb "You never miss the water till the well runs dry" seems to have been overlooked in the anxiety to make two blades of grass grow where one grew before. There is no doubt that should the quantity of water drawn from underground sources increase in the same ratio as in the past two or three years, it will within a comparatively short time so diminish the available supply as seriously to affect the farmer. It is agreed that the underground water-bearing

Generated on 2024-09-30 00:19 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

strata are limited in storage capacity, and that conditions of rainfall primarily govern the replenishment of the supply every rainy season. It would appear to be good judgment to commence an intelligent study of the various phenomena pertaining to this subject now, rather than at some future date when the need of correct data will make itself unpleasantly manifest. It is indeed difficult to bring these facts home to people who are in the zenith of their prosperity, and who feel secure in the feeling that as their wells have been producing steadily in the past, they will always continue to do so. The owners of the great Eastern and Southern coal deposits have mined their coal in the past with prodigal disregard for waste. Today conditions are such that the time for the exhaustion of the deposits may be foretold with a fair degree of accuracy. It would appear at first that the cost of compiling suitable data for the study of the problems of underground water-supply would be enormously high when the great area to be covered is taken into consideration. It has also been suggested that work of this character should properly be a function of the state government. Theoretically, this suggestion would appear feasible, but practically so much time would elapse between the agitation for such a movement and its crystallization into a working organization that it is obvious that a quicker and more effective method of attack should be devised. An attempt to organize the farmers into some sort of a coöperative organization for conducting this work would be an almost hopeless task. Nothing but the spur of urgent and immediate necessity could create sufficient sentiment in favor of this movement to render it possible of accomplishment. The power companies, on the other hand, are interested in this question to an extent almost equal to that of the farmers. There are said to be in excess of 18,000 electrically-operated irrigation pumping plants in California, and this furnishes a class of business that should be carefully conserved. Every power company has a staff of trained men in the field soliciting this business. These men are in complete touch with the situation from the time a well is contemplated until a contract for power has been signed. All the required information could be gathered by the agents of the power companies in the course of their daily work with comparatively little extra exertion. Logs of the wells, depth, quantity of water pumped at stated periods, character of crops under cultivation, and yield could be reported to a general office maintained jointly by the power companies interested, whose duty it would be to compile and correlate the data in such form as to make them of value in soliciting future business. It would enable comparisons to be made of results obtained in cultivating the same crops with varying quantities of water, and by the dissemination of information of this character minimize the waste of water incident to inexperience in irrigation and help to bring the yield per acre to its highest possible point. The expense of maintaining the central office could be borne jointly by all of the power companies interested, thereby imposing a comparatively small burden of expense upon each. If the power companies should ultimately adopt such a course as this, it would strengthen the bond of good will between themselves and one of their best classes of consumers, and promote the use of electric power for irrigating the farms of California.

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

REVIEW OF THE MONTH

BUSINESS affairs, from a financial standpoint, seem to have shown little improvement during the month. The practice in vogue among our retail stores of holding midsummer clearance sales seems to have been extended to the banker and bond broker. Every day is bargain day, and not for many years have first-class securities been offered at such low prices. The man with ready money will reap a harvest when the reaction sets in and the pendulum of business starts to swing the other way. The country is not 'broke,' just a little 'bent,' waiting for the straightening process before proceeding along the path of progress with greater efficiency than ever before.

ANNOUNCEMENT has been made by the committee of management of the International Engineering Congress, 1915, that Colonel George W. Goethals, chairman of the Isthmian Canal Commission and chief engineer of the Panama canal, has consented to accept the honorary presidency of the congress and will preside in person over the general sessions to be held in San Francisco, September 20 to 25, 1915. The committee is to be congratulated for its good work, as it is eminently fitting that so notable a gathering should be presided over by the man who has carried to a successful conclusion the greatest engineering work of modern times.

DAME RUMOR has been busy as usual with reports concerning the activities of the Shell-Royal Dutch oil interests. The latest story is that negotiations are under way for the purchase of the Associated Oil Company's property. No confirmation can be obtained, and it is doubtful if there is any real foundation for the rumor. Unusual activity has characterized the affairs of the Associated company for the past few months. Its proposed new refinery, which was under discussion for many months, is well along toward completion. In fact, it is expected that it will commence operations early in August and that by January next the plant will be operating under full capacity of 10,000 barrels of crude oil per day. The company is adding to its already large holdings near Oil Center, and apparently is getting its defenses in condition to stand a long siege.

OIL has reached Mojave in the new pipe-line of the General Petroleum Company. The completion of this work is especially interesting as giving an opportunity for making comparisons between the methods of pumping used by the General Petroleum Company and those of the older pipe-lines. The first lines installed in California used direct-acting pumps with tandem-compound steam ends. Those of the General Petroleum Company have Corliss, crank-and-flywheel, cross-compound steam ends, and should achieve notable economy as compared to the direct-acting pumps. While there are no figures available for publication at present, we know of one instance where two 250-horsepower boilers were serving a direct-acting pump. A Corliss crank-and-flywheel pump of the type described above was substituted, and it was found that one of the two boil-

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

ers could be shut down altogether and one burner eliminated on the remaining boiler. The speed regulation was so accurate that on a test the Corliss crank-and-flywheel pumps were run for a sustained period at only 14 revolutions per minute when operating against a total head of 500 pounds per square inch. This is good work for a 36-inch stroke engine on oil-pumping duty, and it appears that the engineers for the General Petroleum Company have done excellent work in the design and construction of this installation.

MOTORISTS are joyful over a drop in the price of gasoline to 14½ cents per gallon delivered in tank wagons. The reason for this cut is difficult to give. Popular opinion seems to credit it to the competition of the Shell interests, who are operating in California under the name of the American Gasoline Company. A number of storage and distributing stations have been established on the Pacific Coast, and gasoline is being imported in tank steamers from the Borneo fields. The last consignment received was 2,500,000 gallons, which, while apparently a large amount, actually is small when compared to the total consumption. It has been estimated that there are 75,000 motor vehicles in daily use in California alone, which require 150,000 gallons of gasoline for their operation. This cargo of gasoline, therefore, could operate every car in the state for only about sixteen days. The increase in the production of gasoline from casing-head gas is having its effect, however, and there is no doubt that it will be a factor of increasing importance in the future. The Union Oil Company has already contracted for a plant that will produce 8000 gallons per day, and the Standard Oil Company is said to be considering supplementing its refinery output by this method. A number of small companies have been engaged in this business for some time, the total production from all fields at present being approximately 10,000 gallons per day, which will be more than doubled when the plants now in course of construction shall have commenced operations.

CALIFORNIA is credited in some circles with being possessed of a land boom. The word 'boom,' in its noisy sense, is here without doubt, but we hope that those who become imbued with the 'back to the farm' idea will consider the subject in all of its phases before succumbing to the alluring 'literature' that is being industriously circulated among city-dwellers. Farming therein is depicted as a *dolce far niente* existence, filled with sunshine, fruits, flowers, automobiles, and bank accounts. As a matter of fact, there is nothing to it but hard work. This, coupled with knowledge and skill, will win out, as it will in other walks of life. For the man who knows, who has capital to tide him over the period of non-production, freaks of the elements, and sundry other things with which the farmer has to contend, there are great opportunities in California irrigated land. For the city clerk who, inexperienced in farm work, buys a 10-acre tract on the installment plan in the expectation of immediate returns that will make the farm not only support him and his family, but meet the installments on the purchase price as well, it is courting disappointment and failure. There has been entirely too much irrigated land sold to men of this type and has resulted in bringing into disrepute many excellent projects that, if handled with more judgment by

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

the promoters, could have been made successful from the start. The sale of irrigated farms to investors should carry with it an obligation to make known the truth, not part of the truth, but all of the truth. It is by telling only part of the truth that the real damage is done. An investor is entitled to reports by expert authority concerning all economic features and adaptability of the soil in question. He should be fortified by full knowledge of every condition before being permitted to effect a purchase. This, as a new conception of the responsibility of the salesman, may sound somewhat Utopian from the standpoint of the real estate man, but, in the end, would it not be 'good' business after all? Such a course would soon create a reputation for responsibility and fair dealing that would be an invaluable asset, and make the doctrine of *caveat emptor* a dead letter on the statute books.

IT is interesting to note how willing most of us are to express opinions of the most positive order concerning our neighbors' business. Residents of the east bay shore of San Francisco, who form the army of commuters traveling to and from San Francisco daily, have formed the habit of regarding the suburban lines as the meal-ticket for the entire system. How far this is from the truth is shown by the testimony brought out before the Railroad Commission to combat a request for a reduction in fares from one of the more remote suburbs served by the Southern Pacific Company. The figures for the fiscal year ended June 30, 1913, showed total operating expenses of $1,723,618.92, a passenger revenue of $1,359,636.12, and a deficit therefor of $363,982.80. Moreover, interest on a valuation of $42,000,000 is not taken into account in these figures. On first thought, one is inclined to ask why this enormous investment was made when the preliminary engineering reports must have shown that the enterprise would have been unprofitable. On reconsideration, however, the course taken by the company is the same as is usually taken by any other enterprise of similar magnitude and character. The power-plant and equipment have been installed of such capacity as to be adequate to provide for a large increase in traffic for many years to come, and with comparatively little additional expense. In making the electrical development, which is admittedly unsurpassed anywhere in the world, they built with an eye to the future rather than the present, and it is to the future that the company looks for profits on its investment that will justify the large sums that have been expended, and return a profit that will overcome the deficit that occurs during the early stages of operation and 'then some.' Much money in first cost could have been saved by using cheaper equipment and construction methods, and by installing sufficient capacity for present needs only. That such a course would have been unpardonably stupid is self-evident, as even the most hardened critic of the Southern Pacific Company would agree. As it stands, every commuter is getting more than his money's worth, and will continue to do so until traffic has increased to such an extent as to produce a profit at present rates.

SPOKANE is engaged in a controversy with the Oregon-Washington Railroad & Navigation Company regarding terminal improvements that has brought out some interesting facts concerning bridge building. The plans

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

of the company include the construction of a new bridge over the city structure at Monroe street. The people of Spokane are proud of the Monroe street bridge, and justly so, and are up in arms over the prospect of its appearance being marred by an unsightly, steel railroad crossing. In discussing the attempt to induce the railroad to use concrete instead of steel, Mr. Morton Macartney, city engineer of Spokane, referred to the Latah bridge, a concrete structure that has been contracted for at a price of $416,000. Of this amount, it is estimated that $195,000 will be spent for labor, $89,000 for cement, $34,000 for gravel, $18,000 for sand, and $10,000 for lumber, making a total of $346,000 that will be distributed in and about Spokane. It is estimated that a steel bridge to meet the requirements would cost $264,000, of which 80 per cent would be sent East in payment for material. As a concrete bridge is estimated to cost $450,000, it would appear that the city is asking for an increased expenditure on the part of the railroad of nearly $200,000 in order that the greater part of the money may be expended at home. The question of home industry is one that frequently arises in various localities along the Pacific Coast and is extremely difficult to answer. In this case it would appear that the course for the city to pursue would be to select the type of bridge it desires built as a part of the consideration for the extension of valuable franchise rights. We do not see how it could be demanded on any basis other than value received. The railroad company must also consider what influence its course would have on shippers in the community it serves, and whether it can afford to take such action as would result in the creation of antagonistic feeling that would effect its revenue. Railroads are badly in need of friends nowadays, and a concession to public opinion often turns out to be profitable in the end.

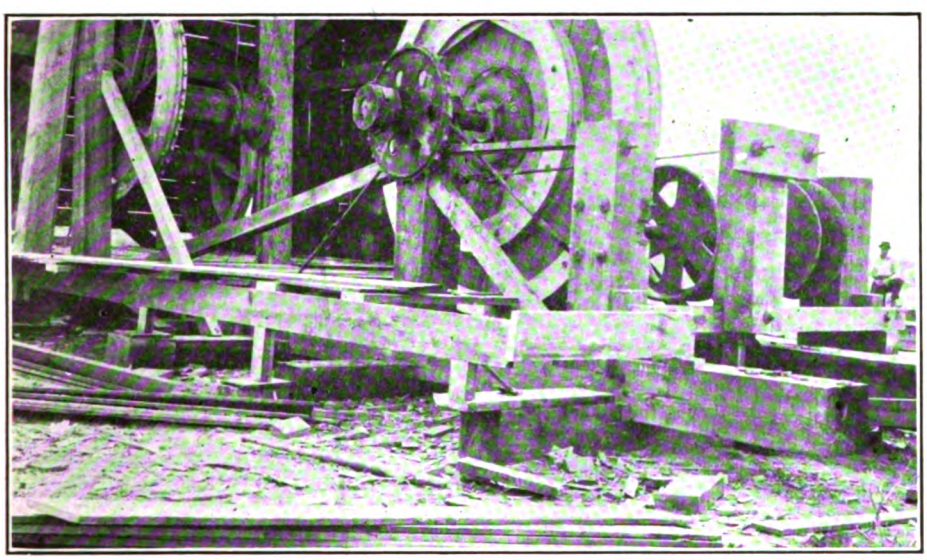
IN view of the state of the financial world, it is interesting to note that the Great Western Power Company has secured $1,250,000 with which to carry out its plans for the development of the Big Meadows power project. A sale has been consummated of $1,250,000 of two-year 6 per cent collateral trust notes to E. H. Rollins & Sons. To secure these notes, $2,082,000 par value in various stocks and bonds has been deposited as collateral security with the Bankers Trust Company of New York as trustee. At present market value, the securities are 25 per cent in excess of the par value of the notes. Funds are thus provided for paying current indebtedness, leaving a surplus for carrying on the improvements contemplated for this year. The present installed capacity of the company aggregates 98,000 horse-power, of which 55,000 horse-power is steam. The development at Big Meadows now under construction contemplates the completion of the dam, the extension of the Big Bend power-house by adding 20,000 kilowatts to its present generating capacity, and the construction of numerous transmission lines. This relieves a part of the financial strain, and it is to be hoped that all of the many meritorious development enterprises now under way in the West may be provided with the wherewithal to continue their work with renewed vigor. California occupies a unique position with regard to the development of hydro-electric power, and including the contemplated improvements, the total is only exceeded in the state of New York.

Generated on 2024-09-30 00:22 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

California Oil-Well Drilling Practice

By B. K. STROUD

THE first drilling for oil in California was done in 1864. From that time to 1900 there were several wells drilled in the state, but the oil industry did not become important until the discovery of oil in the Kern River fields in 1900. Since then the great Coalinga, Midway, McKittrick, and other fields have been opened, and their development has resulted in a gradual improvement in oil-well drilling practice.



RELATIVE POSITION OF CALFWHEEL, BAND-WHEEL, AND SAND-REEL.

The great rush to the Kern River fields attracted Eastern hard-rock drillers, who brought with them the methods employed in the Eastern fields. It is the custom there to drill an 8 or 10-in. hole below the water-bearing formation, and then set a lining or casing to shut out the water. Drilling then proceeds with a smaller bit or drill, and the work progresses rapidly, 75 to 100 ft. per day being the usual rate. In California, however, it was found, by reason of the soft, caving formation, that it was necessary to line the hole with casing from top to bottom, and the work of handling the pipe had to be learned through experience. The object, of course, in any field, is to exclude the water from the oil-bearing formation and at the same time use as few 'strings' or columns of casing to reach the sands as possible. The casing is made in 20-ft. lengths, and in drilling a well it is usual to go 25

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

or 30 ft. below the casing and then insert another length or joint. In early days, if the pipe did not 'go,' the only recourse was to drive it, and if it could not be moved in this way, it was abandoned and the next smaller size was inserted to bottom. In this way several strings or columns were often required to drill a well 800 to 1000 ft. deep. Again, the tools, cable, pipe, and other equipment used were entirely too light for the character of the work, and operation was therefore expensive.

In 1902 the calfwheel was introduced for handling casing, while heavier casing was later adopted, as well as improved tools, casing-shoes, under-reamers, wire lines, etc. Again, the drillers had learned better methods of keeping the casing from becoming stuck or 'frozen,' as it is termed, and with the above implements a great deal of time and money was saved. The drilling of oil wells, like any other industrial work, is a matter of common sense, and the driller is an expert mechanic who should spend at least two or three years to learn his trade. He must be reliable and resourceful, for often thousands of dollars in property is in his charge, and one slip might result in ruining a well. His helper or tool-dresser should know how to fire a boiler and keep the different parts of the rig in repair, as well as dress the bits. Two drillers and two tool-dressers constitute a drilling crew, running shifts or 'towers' of twelve hours each.

To the ordinary observer, the drilling-rig is a crude-looking affair with its rough wheels and timbers, and while it is true that some of the details of our present drilling rigs might be improved upon, yet it must be remembered that an extra heavy derrick, such as is shown in the accompanying illustration, with outside girts and braces, is capable of withstanding very heavy strains, loads of 50 to 75 tons of casing plus the additional 'friction' from the caving mud in the well not being unusual. The elasticity of the wooden structure has many obvious advantages over the steel derrick, in addition to the crystallization which might occur in the members of the latter. The position of the different working parts, such as the calfwheel and bullwheel, can hardly be improved upon for convenience of manipulation. The ordinary standard-tool derrick is 80 ft. high, with a 20-ft. base, supported by footings of wood or concrete. Such a derrick contains about 25,000 ft. of lumber and can be erected by a crew of 5 or 6 men in 6 or 7 days. The floor is supported by 8 by 8-in. beams and is made of 2 by 12-in. material, the sills being 16 by 16-in. timbers for the band-wheel foundation. The important features of a complete rig are as follows: bullwheels, the shaft of which is about 16 in. by 13 ft., with 4-in. iron gudgeons or bearings at each end, which fit into upright posts; about 24 in. from each end are 8-ft. wooden wheels, the right being the brake wheel, and the left the tug or pulley wheel. Motive power is conveyed by the bull-rope from the band-wheel. The bullwheels carry the drilling cable of manila or wire rope and support the tools when drilling is not in progress, the drilling cable running to the crown sheave which is in line with the hole. The calfwheel is placed on the left side of the derrick, has a shaft 16 in. by 6 ft. with 4-in. bearings at either end, while a 7-ft. wheel with an iron sprocket is placed on the left end. An iron sprocket chain runs to a 3-ft. sprocket on the band-wheel. The calfwheel is used to raise or lower the casing. There are 4 sheaves on top of the derrick and the calf or casing line is threaded from

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

the shaft over these to an extra heavy 32-in. casing block with a 6-in. hook. A band-wheel sets 15 ft. in front of the derrick and is built on a 6-in. shaft, the latter being supported by jack posts which are in turn mortised into 16 by 16-in. sills. On the right end of the shaft is a crank having 5 holes for the wrist-pin, while on the shaft end is the sprocket and clutch by which is run the calfwheel. On the left side of the band-wheel are the 7-ft. bull-rope pulleys, over which the bull-ropes travel to the bullwheels. The band-wheel is connected to the drilling-engine by a heavy 12-in. rubber or canvas belt. Just back of the band-wheel, as is shown in Fig. 1, is the sand-reel, on which is wound the sand-line or bailing line.

This reel has a double-compartment drum, 12-in. diam., one compartment of which carries the line actually in use, while the other carries the reserve line, thus avoiding running over the unused portion. A friction wheel on the sand-reel shaft-pulley, 42-in. diam., sets just in back of the band-wheel and is drawn against the latter by a swing-lever which is operated inside of the derrick. The sand-line runs over a pulley on top of the derrick and is in line with the hole.

Just outside the derrick, and mortised into the main sill, is the sampson-post, 16 in. by 16 in. by 16 ft., which supports the 26-ft. walking-beam, in the centre. One end of the walking-beam, when drilling is in progress, is directly over the well, while the outside extends over the crank-shaft and is connected

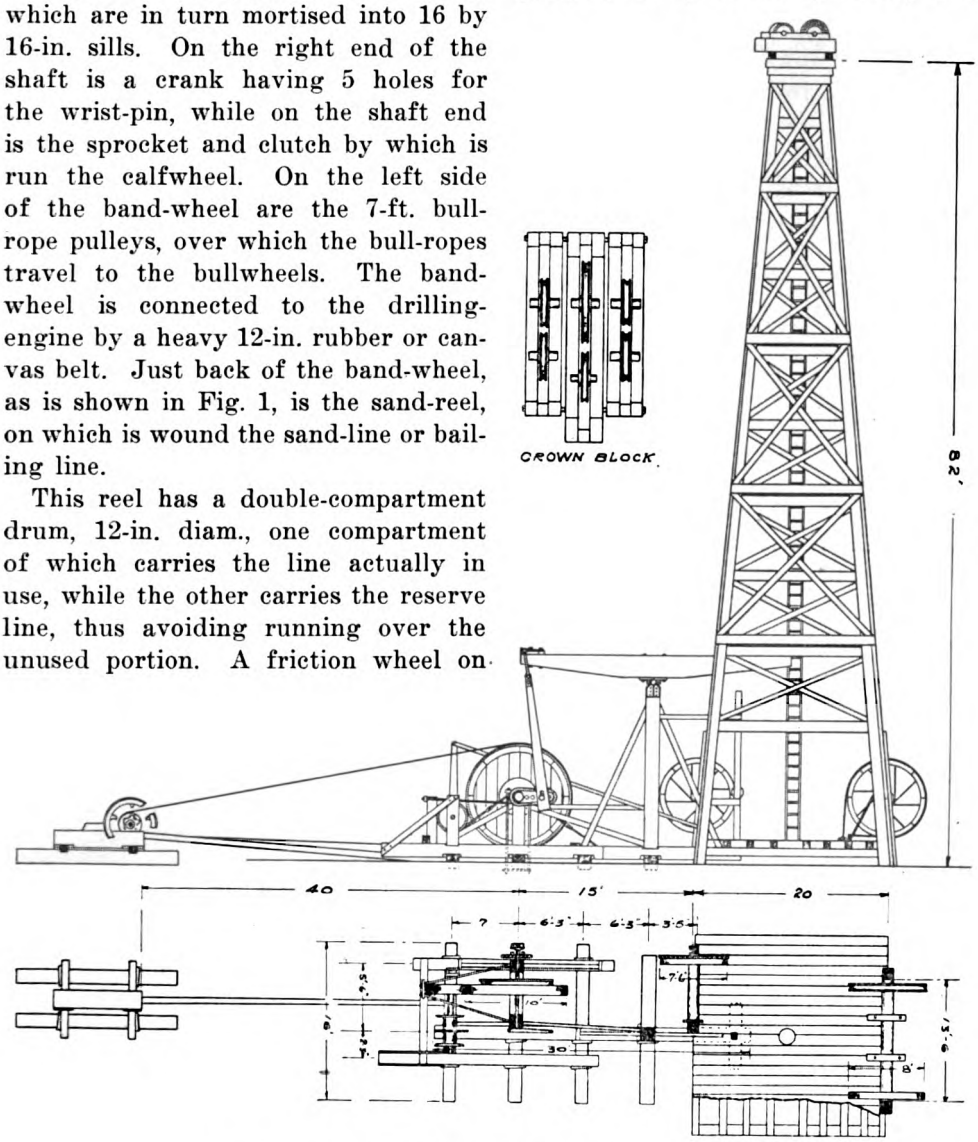


FIG. 1. HEAVY DERRICK WITH OUTSIDE GIRTS AND BRACES.

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

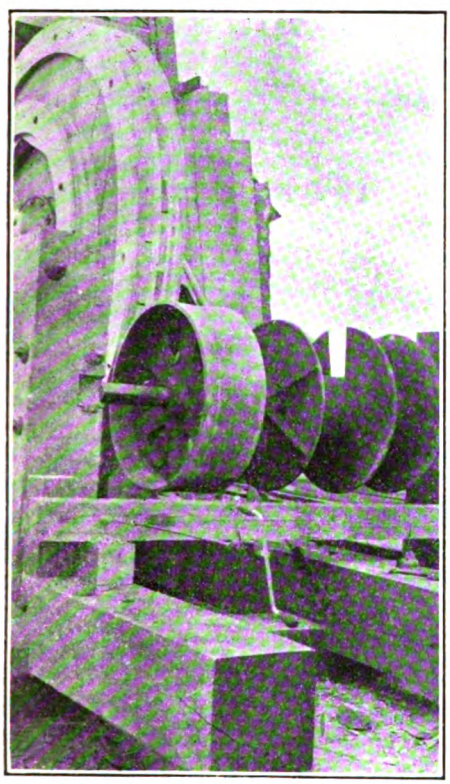
to the wrist-pin in the crank by a pitman 12 ft. long. The temper-screw, by which the tools are gradually lowered when drilling, is placed in a slot on the inside end of the beam. This screw is 6 ft. long and is controlled by clamps at the lower end. As will be seen in Fig. 1, the sampson-post is securely braced to the main sill, and against the forward brace stands a 6 by 6-in. timber 12 ft. long known as the 'headache' post. This is where the throttle-cord, the reverse-lever, the sand-reel lever, and the calfwheel-lever are all placed, and it is here that the driller stands. The headache-post prevents the walking-beam from falling upon the driller should the pitman, wrist-pin, or beam break. The drilling engine, which is set upon a 22 in. by 22 in. by 8-ft. block, mortised into sills, generally has a 10½ by 12-in. steam cylinder, and is of the reversible-link type. A cellar, 8 by 10 by 20 ft., is sunk beneath the derrick floor and facilitates handling the casing.

When the rig builders have completed the rig (this is contract work), the drilling crew of four men takes possession and prepares for drilling, or 'rigging up,' as it is called. This consists of installing a 40-hp. boiler in loose brick and dirt, putting a dump-box for carrying the drillings to the sump, putting the brake-bands on the calfwheels and bullwheels, lagging the band-wheel with manila cable, fitting up the calfwheel clutch and sprocket, putting in a bit-dressing forge, stringing the calf-lines, putting on the manila drilling-line and sand-line, and laying water-lines, etc.; besides stringing the drilling tools and the bailer. The drilling tools consist of a rope-socket, jars, stem, and bit, in the order named, for the size of the hole being drilled. They are screwed together by a powerful jack operated on a circular track, and two men are required to tighten the large joints or couplings. The joints, which are tapered to make the coupling easier and to protect the threads, are made of soft annealed steel and have a shoulder about 1 in. wide which prevents them from unscrewing in the hole. In the larger size of tools the couplings are 4 in. at the base, 3 in. at the top, with 7 threads to the inch, and are therefore called 3 by 4—7 joints. Similarly 4 by 5—7, 2 by 3—7, and 1¾ by 2¾—8 are the joints used, depending upon the size of the casing and the formation. The rope-socket for manila cable has a 2¼-in. hole bored through the top and coming out tapering on the side 12 in. below. The cable is pulled through this bore and the end interlaid with short pieces of rope. When pulled tightly into place, a wedge is formed, making an effective connection with the tools. A 1⅛-in. hole is bored through the wire-line socket and contains a recess just above the joint. The wire-line is thrust through this hole from the top, the ends are turned back to fit the recess, after which babbit is poured in, thus preventing the line from pulling out of the socket.

The 'jars' are not used until the hole has reached a depth of 150 ft. or more. They resemble two great links of a chain and have about 16-in. stroke for ordinary drilling. When the tools become fast from caving mud or any other cause, as often happens, the jars are loosened sufficiently to permit an upward blow, eliminating the strain on the cable which would otherwise be necessary. When a heavy blow is desired, as in jarring on pipe or fishing out lost tools, a 36 or 40-in. stroke-jar is used to give a longer stroke and a harder blow. The stem in such a case is placed above the jars, that its additional weight may increase the force of the blow. The stem in the larger

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

tools is 4½ in. by 28 ft. long, 6-in. diam. at the joints; inside the joints, as on the rest of the tools, are 4½-in. squares for the tool wrenches which are used in tightening the joints. The bit is screwed into the box or coupling of the stem. A complete string of tools weighs about 1½ tons. In the East-



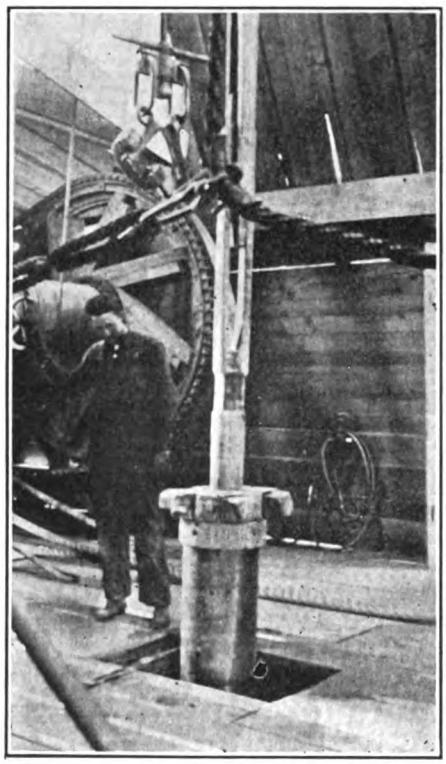
SAND-REEL.

ern fields it is usual to dress the bit to a chisel point in order to cut the hard rock, while in California the centre of the bit is cut out, making a concave surface with the outer edge or cutting surface from 2 to 4 in. longer than the centre. The cutting edge has an offset or lug 2 by 3 in. larger than the shank or body of the bit to permit a larger hole being made below the casing. The California bit is best adapted to drilling conditions here, due to the fact that the soft formations are more easily drilled but harder to mix with the drilling water; in fact, the whole proposition is one of mixing the cuttings thoroughly with water rather than the actual drilling, which is, in itself, comparatively easy. A chisel-bottom bit would therefore dig faster than the mud could be mixed, in which case headway would be slow, as the tools would not drop freely and drillings would be too thick to be removed by the bailer. A large watercourse is also provided on each side of the pit which allows the water to mix more freely with the formation. The bottom of a California bit is shown in Fig. 2. The four corners should always be kept out to gauge or within a circle about ¼ in. less than the diameter of the casing. The occasion often arises where it is impossible to use an under-reamer to ream or enlarge the hole through hard formation or 'shells,' in which case the bit is often dressed in what is termed by oilmen as 'side-hill style'; that is, the bit has one cutting edge or lug drawn out 1 to 1½ in. larger than gauge, while the other edge is beaten in somewhat, thus making a one-sided tool, which as it turns at bottom, makes a hole much larger than it would ordinarily. It is customary to use this style of bit in drilling through stove-pipe casing, where the use of the under-reamer is impossible, or in other words where the reamer cannot safely be used.

The under-reamer is a specially designed tool, which, as its name implies, is used to ream or enlarge the hole below the casing when necessary, as, for instance, enlarging a hole through sticky blue clay, or shells of limestone, sandstone, etc. The best under-reamers have been designed in the California oilfields and are superior to anything used elsewhere. They have two lugs or cutters, which, when fully ex-

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

panded, will cut a hole larger than the casing shoe, giving the casing ample room in the well. A 10-in. underreamer will make a 13½-in. hole, while the shoe is 12-in. diam. These cutters are held in place by a powerful spring, and can be pulled down to a smaller diameter than the inside of the pipe. When reaming is to be done, the bit is



DRIVING STOVE-PIPE, SHOWING PIPE ON THE STEM.

taken off the stem and replaced by the reamer, the cutters are pulled together on the derrick floor by means of a bolt, and the string of tools started down the hole. Upon going out of the pipe, the spring expands the lugs back to a shoulder against the body of the underreamer when they are ready for work. Upon being withdrawn, the cutters strike the shoe or end of the casing and are pulled in, and the reamer can then be withdrawn from the well.

The wrenches for setting up the joints are massive, weighing from 250 to 450 lb. each, and are counterbalanced by weights suspended from the derrick. For driving pipe, two pieces of iron, 6 by 6 by 16 in., are securely bolted to the upper wrench square on the stem, and strike the drive-head, which rests on top of the casing. For this work, a spudding-shoe is placed on the drilling line, which is pulled out from the bullwheel shaft, and a jerk-line is run from the shoe to the crank-shaft and there placed over the wrist-pin. When the engine is started, the crank-shaft, due to the offset, pulls the tools back 24 in. or more, according to the hole the wrist-pin is in, and allows them suddenly to drop, thus delivering a hard blow.

For removing the drillings from the hole, different designs of bailers are used, the principle being the same in all; that is, a valve is placed at the bottom of a smaller size of pipe than the casing being drilled, and a bail is riveted at the top of the pipe. The valve opens when it strikes the mud or water and closes when the bailer is being withdrawn from the hole. In the flat-bottom bailer, a hinged valve resting upon a seat is used, while in the dart-bailer a ball and seat with a dart for a guide answers the purpose. In the Morahan and other special bailers, suction is provided by means of a long plunger with a valve at the bottom, and this form is often used for removing sand or broken particles of iron from the well.

In nearly all the California fields, it is usual to begin drilling with a manila cable, it being more elastic than the wire line and not so severe upon the rig. Again, because of its spring, faster time can be made, until water is struck in the hole. Then the wire-line is substituted, as it permits the tools

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

to drop more freely into the water. The manila cable is 2⅛ to 2¼ in. diam. and is made from selected manila fibre. Manila sand-lines were formerly used in this state until the wire sand-line was substituted. The bull-ropes, 2½ in. by 90 ft., are made of manila rope, two eyes being spliced at the ends to make an endless belt.

Wire drilling lines were introduced in the Kern River fields at first, and their use was a decided innovation. The first lines were unsatisfactory, as drilling conditions were not thoroughly understood, the lines being new to the drillers. The principal defects, however, such as hardness, softness, inelasticity in the respective makes, have been largely remedied, until at the present time the wire-line is used in all California fields, the tools turning as well with it as with the manila cable, while again it stands far more abuse and has proved better for deep-hole drilling. The sizes used are either ⅞ in. or 1 in. for ordinary drilling, the ⅞-in. line having a breaking strain of 24 tons and working strain of 4.8 tons, while the 1-in. line has a breaking strain of 31 tons and a working strain of 6.2 tons. They are usually composed of 6 strands of 19 wires each, and a hemp centre. The sand-lines are from ½ to ⅝-in. diam., 9/16 in. being the size most generally used, and are composed of 6 strands of 7 wires each and a hemp centre. Wire drilling lines are nearly all left idle, and when the tools strike bottom, the tendency is to tighten rather than unscrew the joints. The casing-lines are either ⅞ or 1-in. diam., and have about the same breaking and working strains as the drilling lines. As before described, the casing line is threaded over the four casing pulleys and through a three-sheave casing-block, making seven lines in use. Nine lines are often required to carry strings of casing when extra long.

For wells of 2000 ft. or more in depth, the usual procedure is to use 600 to 800 ft. of 16-in. stove-pipe, 1400 to 1600 ft. of 12½-in., 2000 of 10-in., and to carry the 8¼-in. into the oil-sands. The 12½-in. is cut off inside the stove-pipe or withdrawn entirely from the well, while the 10-in. is cemented to case out the water. The 8¼-in. is often cut 50 ft. inside the 10-in., and the upper portion pulled, leaving a liner in the sand, thus effecting a saving in casing. The following table is given to show the usual sizes and weights.

The stove-pipe, which is made of No. 10 gauge iron, is put together one piece inside the other and riveted at the ends and centres, the pieces or sections being 2 ft. in length, no couplings being used. Before being lowered into the well, the pipe, which is used in 10 and 20-ft. joints, is picked or dented in order to hold the sections more firmly together, and the column is handled by wooden friction-blocks. Stove-pipe casing is designed to case-off running sands, the absence of couplings keeping it from freezing, but it cannot readily be pulled, as is the case with the screw-pipe, for all that holds it together are the dents made by picking.

The elevator used for lowering or raising screw-casing has two heavy links which are placed on the casing-hook. The body has a hinge by which the elevator may be opened to admit its being placed around the casing under the top coupling, after which it is closed and a latch thrown up to prevent it from opening. There are several patterns now in use, all built more or less on this principle. All casing must be firmly screwed together to prevent loosening in the well, and several makes of tongs are used for this purpose, a jerk-line running from

Generated on 2024-09-30 00:26 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LAP WELDED CASING

Sizes generally used in oil fields

Nominal Inside Diameter Inches	Outside Diameter Inches	Thickness Inches	Inside Diameter Inches	Threads per Inch	Wgt per Foot	Outside Diameter Coupling	Weight Coupling Pounds
6¼	6.625	.289	6.047	10	20	7.390	18.559
6¼	6.625	.390	5.845	10	26	7.390	18.559
8¼	8.625	.322	7.981	10	28	9.627	33.096
8¼	8.625	.405	7.815	10	36	9.627	33.096
10	10.750	.366	10.018	10	40	11.866	45.365
12½	13.000	.290	12.420	10	40	14.116	54.508
12½	13.000	.325	12.350	10	45	14.116	54.508
13½	14.000	.335	13.330	10	50	15.151	67.912
15½	16.000	.420	15.160	10	70	17.477	98.140

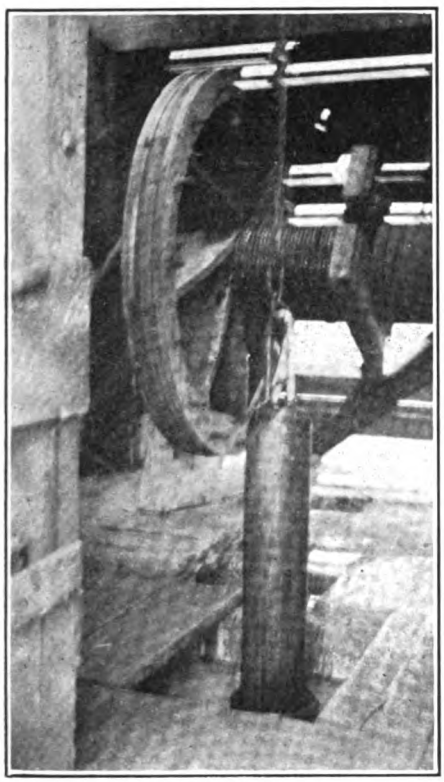
the crank-shaft to the tongs for power.

The tools having been screwed together by the jack, are lowered to the cellar bottom and 15 or 20 ft. of slack run off the bullwheel shaft; the spudding-shoe is placed on the manila cable, the jerk-line put on the wrist-pin, and all slack taken up by the bullwheels until the tools are suspended on the cable, when the bull-rope is thrown off and the bit begins striking bottom at each revolution of the crank-shaft. As fast as the bit digs away, the bullwheel-brake is raised and the tools lowered sufficiently to be kept on bottom. Enough water is run into the hole to keep the drillings thoroughly mixed, the tools being turned by hand to keep the hole round and straight. As soon as enough mud has been mixed to retard the free drop of the tools, the bull-rope is thrown on, the tools pulled out, and the bailer run to remove the débris, after which the tools are run in again and drilling resumed as before. When a depth of 130 to 150 ft. has been reached, it is usual to discard the jerk-line method and put the tools 'on the beam'; that is, to use the beam with the temper screw. This has been found to be about the proper distance to 'hitch on', as it is called, as there is enough spring or stretch in that amount of cable to strike a hard blow; also, at this depth the driller ceases turning the tools, as they will turn themselves from now on. The action of drilling tools may be likened to the cracking of a whip, for in the latter case, when the lash cracks or pops, it will be noticed that the hand is pulling the whip-handle back, and this is what happens when the tools strike bottom. That is, the drilling is done by the spring in the line: this action in itself causes the cable to draw tightly and therefore twist to a small degree, insuring the turning of the tools.

When a depth of 200 or 300 ft. has been reached, or at the point where the hole begins caving, it is usual to put in the stove-pipe, the whole crew working day and night on such jobs. As stove-pipe is not designed to stand a pulling strain, it should not be

Generated on 2024-09-30 00:20 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

clamped at the surface unless there is enough 'friction' in the hole to keep it from parting. It is generally turned loose, however, and when it does not sink down or follow the tools of its own accord, it can be driven. When passing through running-sands, the casing should be kept on bottom and the well bailed as little as possible,



BAILER ENTERING HOLE.

while 'shells' and clays should be reamed with a 'side-hill' bit and short pieces of wire line are occasionally thrown into the well to hold the tools up and enlarge the hole. Stove-pipe often collapses, or an inside section may become loose. If this happens near the bottom of the string, the collapsed or torn portion can be driven on to bottom and there drilled out. Should the casing become frozen or should it part higher up, an inside string of screw casing is run in and a hold taken near bottom by means of a 16-in. swage with slips, and the whole column withdrawn from the well, when a fresh start can be made. As it is desired to carry the stove-pipe through all the surface formation, a distance of usually 700 or 800 ft., in order to protect the 12½-in. casing from caving sands, great care should be used to keep the hole large and straight.

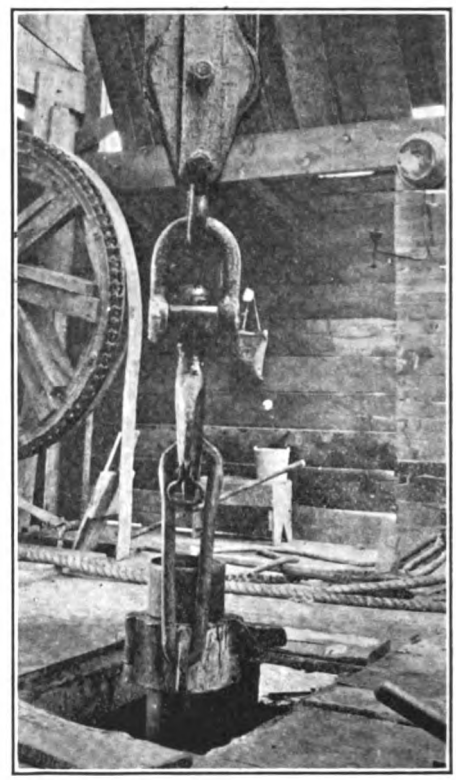
It will be seen that the 20-in. cellar is necessary to allow space for driving a full joint if necessary, as well as to give room for action to the temper screw above the derrick floor. At the bottom of the cellar are placed two 16-in. by 16-in. by 8-ft. sills, and the stove-pipe is cut off below them, while the casing-spider, through which all the screw-casing is handled, rests upon the sills. The spider is a large beveled ring with the large side up and has two projecting lugs for its support. The casing runs down through the spider and can be hung up on the latter at any depth by inserting four curved steel slips with teeth inside projecting upward, which act as wedges between the casing and spider when placed in the latter.

A steel casing-shoe, highly tempered at the bottom, is used on all casing to prevent the pipe from pinching or collapsing, as well as for protection when drilling. It is from 12 to 16 in. long by ⅞ to 1¼ in. thick, slightly beveled at the lower end to form a cutting surface, and has a shoulder about 6 in. from the bottom against which the casing butts, while the sleeve is from 8 to 10 in. long and large enough to admit of babbit being poured into the annular space between the shoe and the casing. There are special patented shoes which aid largely in keeping the casing free, in that they cut a hole larger than the couplings and can be forced through formations that a plain shoe

Generated on 2024-09-30 00:24 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

could not. They are constructed with teeth at the bottom and the weight of the casing setting on them makes an effective cutting tool. In carrying long strings of casing, however, it is always well to under-ream the entire hole, to prevent the casing from 'freezing' or being stuck through mud or sand lodging against the couplings. The latter, due to the fact that they are larger than the casing itself, are the main causes of the pipe 'freezing,' for nearly all the débris falls on them. When there is several hundred feet of friction surface, the casing should be moved every hour or so, and sometimes oftener, to keep it 'free.' When it becomes 'logy,' as it is termed, through the mud sloughing off the walls, the entire string must be withdrawn far enough to permit the mud to fall to the bottom, when the casing will free. The hole can then be cleaned out and drilling resumed. This procedure is necessary in some cases as often as every other day, and drilling is consequently slow. Water is also a great factor in keeping the casing from becoming 'logy,' as it holds the mud back and prevents the sand from running in, and it should be kept at as nearly the same level as possible in the well for the above reasons. Every joint should be measured from the inside end of the thread to the end of the collar, and the measurements checked within a foot of the sand line measurement, as it might save complications in a possible fishing job later on.

Drilling is resumed as before when the casing has been run to bottom, the driller being careful to keep the hole round and straight, and free from débris, as well as see that the casing does not become 'logy.' If the formation drilled contains boulders, the reamer should be run to pull them in from the walls and drive them to the bottom, for if left behind the casing, they are liable to roll in and mash it, thus making a pulling-job. Should a large stratum of sticky blue clay be encountered, a sinker-bar or short stem 8 ft. long should be added to the tools above the jars to knock the bit loose when



LIFTING CASING, SHOWING ELEVATOR, CASING HOOK, AND BLOCK.

it dives or sticks, as is usual in this formation; this lessens the strain on the drilling line and beam, as well as saving a great deal of time.

Blue shale gives no trouble whatever in some localities, while in others it caves badly, often freezing the casing. Brown shale is more easily drilled than any other formation, as it stands well, while gray shale caves more but is readily drilled. When a running-sand is encountered, sticky clay should be dumped into the hole in sufficient quan-

Generated on 2024-09-30 00:21 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

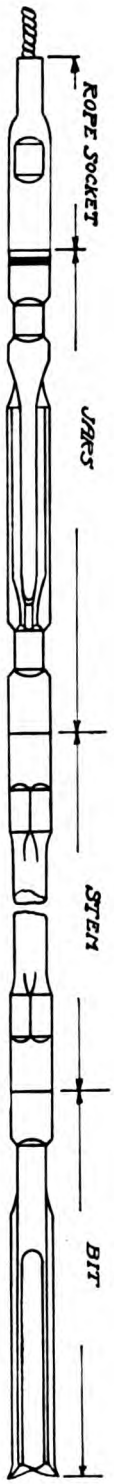


FIG. 2. STRING OF TOOLS.

tities to 'mud up' the walls, but when a hundred feet or so is to be drilled with screw casing, a pump should be installed, the clay mixed with water to the consistence of thick mud and circulated back of the casing continually. A long plunger working through a circulating head is placed over the drilling line, making a packer, so that drilling and pumping can be carried on at the same time. This is called the 'circulating method,' and its use is sometimes required for nearly the entire depth of the hole.

Should the casing become frozen from sand, lowering the water by bailing will often cause the sand holding the pipe to run in, thus relieving the latter. Pulling and driving the casing will often free it when frozen in any formation, and bailing the water often helps, but when these methods fail, and if it is necessary to free the string to carry it deeper, the casing spear or explosives are resorted to. The casing spear has two or four slips, depending upon the make, which work in slots or grooves, beveled, with the larger end below, on the body of the tool. The slips have teeth turned upward and when the spear has been lowered to the point where the jarring is to be done and pulled up, the slips engage with the casing, at the same time acting as wedges between the casing and spear, as the beveled body of the latter forces them out. A strain having been previously placed upon the casing by the calfwheel and jacks, the walking-beam is put up and the temper-screw attached to the drilling line. The jars are loosened sufficiently to permit the stem to deliver an upward blow, and jarring is continued until the casing comes loose or is found too tight to move, when the spear is withdrawn. This is accomplished by driving down on the spear with the stem until it

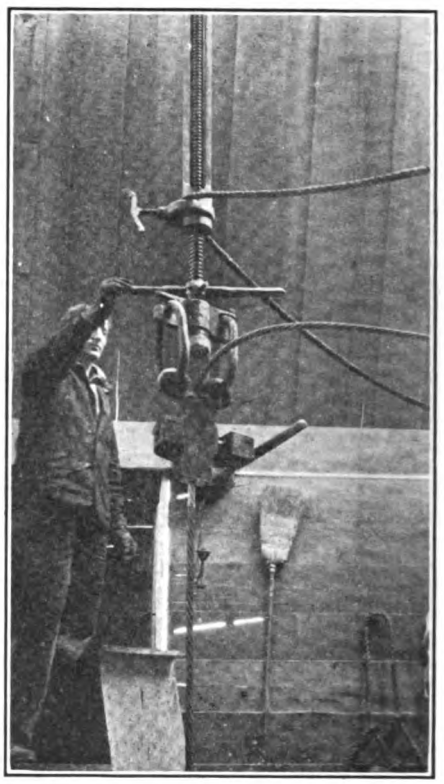
Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

falls away from the slips. The latter are then caught on the smaller part of the bevel by means of lugs, which are forced out by springs from the body of the spear so they do not touch the casing, and the spear can then be withdrawn from the hole. Spears are never run except in cases of extreme necessity, for at best they are a dangerous tool and are liable to go wrong and plug the well. In some of the deeper fields, the use of spears has been almost discontinued because they seldom move a string of casing once frozen, as there is danger of breaking down in the hole. If a string of casing is to be used to shut out water, it is always best to pull it out and inspect the joints where the spear has been working, to make sure there are no split joints.

In shooting, a 40 to 80% explosive is used and is fired by fuse or battery at a point above where the casing is supposed to be free. Upon shooting, the casing is pulled, leaving the lower portion in the hole, a new shoe is put on and the string run back. If there is 40 or 50 ft. between the shoe of the last string and the top of the shot portion, the latter can usually be side-tracked without much trouble. In shooting, it is well to leave at least 40 ft. of casing in the hole, for it will stand upright and can be side-tracked more easily. It is not unusual to leave 500 or 600 ft. of casing in the well in this way.

If the casing parts inside the next larger string, it is a simple matter to run a steel-die nipple or collar and screw on the lower portion, but if the casing parts below the next larger size, it has to be side-tracked or drilled, provided it does not stand straight enough to admit being screwed together. Drilling casing is not as serious as it sounds, for the great weight of the tools makes it comparatively easy. When the casing has been carried as far as is necessary, it is supported at the surface by clamps, which rest on the cellar sills, and the next smaller size is run in.

There are few holes drilled where trouble from lost tools or damaged pipe

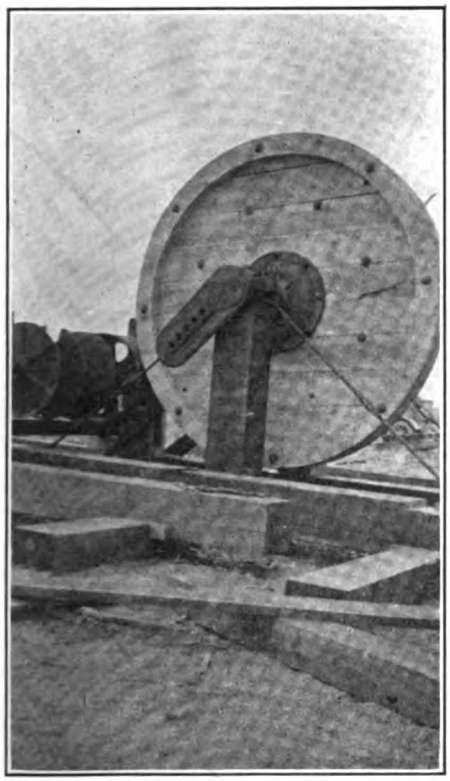


DRILLING WITH WIRE LINE, SHOWING TEMPER-SCREW.

does not arise. All the fishing-tools used are too numerous to mention in this paper. A few typical ones will be described, however, together with the occasions for using them. Should the drilling line of manila or wire-line part in the well, some distance from the tools, a centre-rope spear or three-prong grab is run in on a second string of tools. The centre-rope spear is a pointed piece of steel 6 ft. long and having wickers or barbs which project

Generated on 2024-09-30 00:22 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

upward. The spear is driven into the broken rope sufficiently far for some of the strands to catch on the wickers, when a pull is taken; this is repeated until all the line in the hole has been broken off and pulled out, or until a



BAND-WHEEL.

strong enough hold is obtained to withdraw the lost tools. The three-prong grab has three arms with wickers on the inside and is used in the same way. Should the cable break just above the rope socket on the tools, a slip-socket is run. It has a bowl at bottom with an opening large enough to admit the lost tools, with about ½ in. additional clearance. The bowl is beveled on the inside with the larger taper at the top, and the slips fall into this space when the socket is placed over the tool to be fished out. Upon taking a strain, the slips form a wedge between the two and a hard blow can then be delivered by the beam, if necessary. As the tools are seldom carried out of the casing, there is no great risk in a job of this description. Should the bit unscrew or break at the joint and fall against the wall, however, the job might prove serious and eventually end in plugging the well. An impression-block made of wood and faced with sheet lead should first be run to ascertain the position of the bit. If it is standing straight in the hole, a socket can be run to remove it, but if it is leaning over against the wall, a spud made of 1 by 6-in. steel and having an offset at the shank can be used to get in behind the bit, and by tamping in clay, coal, or other material, cause it to assume an erect position, where it can be fished out. A hook will often catch hold of a bit on the tool-wrench square, if it does not stand too far out of line. There are also special fishing tools designed to fish out broken jar-reins, under-reamer cutters, etc., but it is often necessary to blast lost tools into the walls and sidetrack them with the casing, as they defy all attempts at recovery.

Crooked or flat holes result from crowding the tools; that is, drilling with tools too loose, while in some localities, by reason of the sharply inclined strata, great care must be exercised to avoid them, as the tools naturally follow the line of least resistance. A crooked hole may be straightened, if discovered in time, by swinging the bit, followed by the under-reamer at the beginning, but should the hole have been carried too far, it becomes necessary to fill back the cavity with hard rock, when a new shoulder for the straight hole can be begun. A flat hole is caused when the tools fail to turn and is corrected by swinging the bit through the bad por-

Generated on 2024-09-30 00:23 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

tion, followed, if necessary, by the reamer.

"An ounce of prevention is worth a pound of cure" is particularly applicable to the drilling of oil wells, for many fishing jobs are caused by worn-out lines, bad threads on the casing, or the tool joints being in poor condition, while other jobs are caused by carelessness in taking measurements or by some other lack of knowledge of well conditions. All equipment should be kept to a high standard of efficiency, and no tool should be allowed in the well if not in first-class condition.

Above all, good drillers should be employed and kept in the same locality as far as is possible, for their knowledge of the territory after the first well has been drilled will result in faster progress being made and more accurate data obtained in the later wells.

Irrigation Project of the Sacramento Valley Irrigation Company

By R. A. BALZARI

FOUR miles north of Hamilton City on the Sacramento river is situated one of the largest electrically driven irrigation plants in California, known as the Head Gate plant of the Sacramento Valley Irrigation Co. Several years ago the Central Canal Co. attempted to place under irrigation, by a plant at this point, about half of the land in upper Glenn and Colusa counties. At this time they installed their first unit, consisting of a 250-hp. motor, which was belted to a 44-in. centrifugal pump, rated at 60,000 gal. per minute, against a normal pumping head of about 8 ft. When this plant was put in operation, the canal was run from the Head Gate plant to a point directly below Willows and surveyed around back of Maxwell, Williams, Arbuckle to a point near College City. Due to lack of capital, this company was severely handicapped; in fact, the development was at a standstill when the Central Canal Co. was purchased by the Kuhns of Pittsburg, who re-named the project, the Sacramento Valley Irrigation Company.

Due to the fact that the head at this point is very low, ranging from 1 ft. minimum to a maximum head of 8 ft., D. W. Ross, chief engineer of the Sacramento Valley Irrigation Co., found it necessary to obtain a special design of pump to obtain a good plant-efficiency. After considering numerous plans a design submitted by O. C. Goeriz, of San Francisco, was selected. The pump resembles the high-pressure end of the Westinghouse-Parsons steam turbine, and comprises a rotating or central runner, operating between two guide vanes. These guide vanes act the same as in a steam turbine, to give direction to the water on entrance and exit from the runner. The runner is carried on a vertical ball-bearing, which takes care of the weight of the runner as well as the end-thrust due to the back-pressure

Generated on 2024-09-30 00:22 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

of the water. The runner is operated at a speed ranging from 40 to 60 r.p.m., depending on the head against which the pump operates.

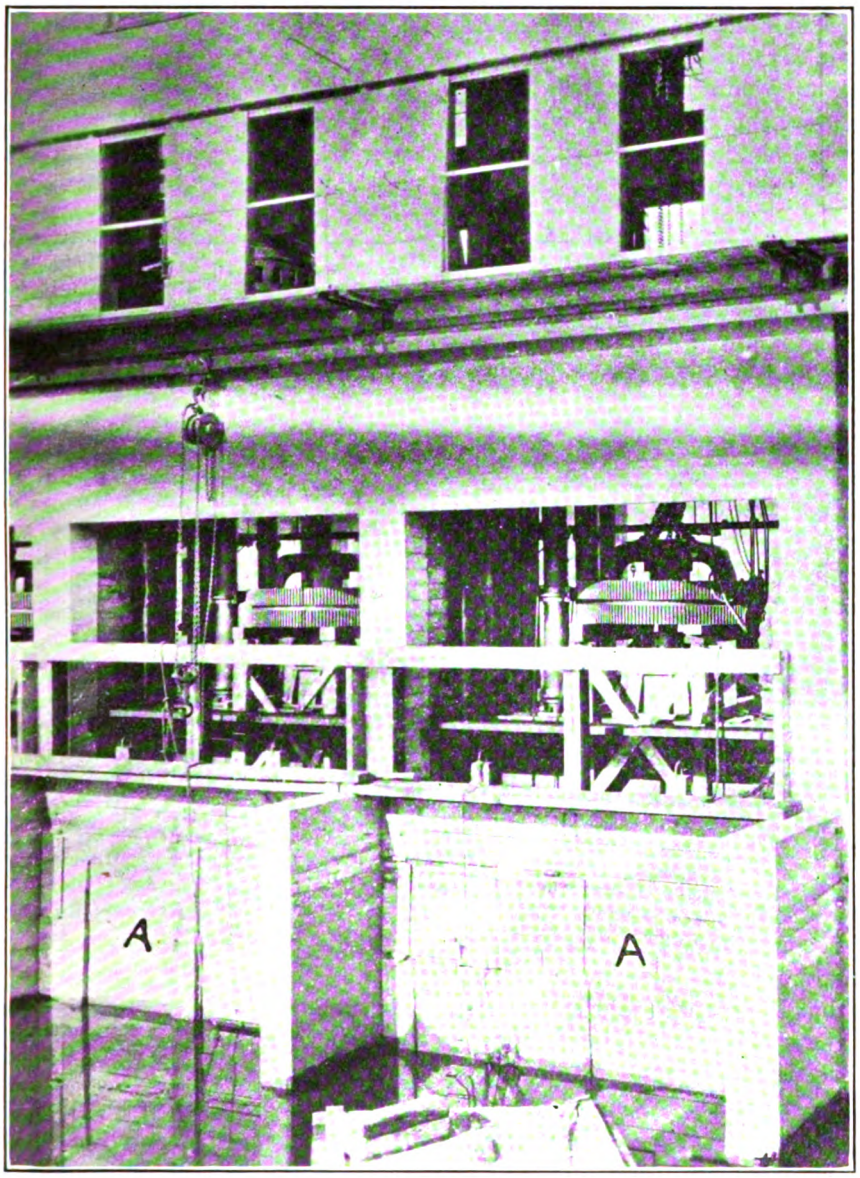


FIG. 1. VIEW OF PLANT, SHOWING DRIVING GEAR.

By referring to Fig. 1, a general view of the plant and an idea as to how it is installed may be obtained. The turbine pump is situated directly behind the gate *A*. The runner of the pump is mounted on the same shaft as the large gear, shown just above the gate. This gear is driven by a pinion, which is mounted directly on the extended shaft of the vertical motor shown at the upper door in the illustration. The motor and pinion shafts are so ar-

Generated on 2024-09-30 00:19 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ranged that they can be moved as a unit, thus permitting the use of several different pinions, and in this way varying the speed of the turbine. Thus the maximum efficiency of the turbine at several heads is obtained. The gates *A* are used as check valves to prevent the water from rushing back in case the power should fail or when the pumps are shut down. If it were not for these gates, the flow of the water would reverse the rotation of the pump, which would soon reach such excessive speed that the plant would be wrecked.

On the river side of the plant are two screens, one at the mouth of the canal, which is about 100 ft. from the plant shown in Fig. 2. The second screen is situated directly ahead of the pump, the two being so arranged that no fish or rubbish can get into the pump runner.

The electrical machinery at the present time consists of three Westinghouse vertical motors, wound for 2000 volts, three phase, 60 cycles, and running at 435 r.p.m., together with one 350-hp. horizontal motor, 2000 volts, three phase, 60 cycles, 580 r.p.m. The vertical motors are direct connected to the pinion shaft through a flexible coupling. As a safeguard, in case anything happens to the pump, a bolt is placed in the pinion-shaft line, so that if the power exceeds a pre-determined point, this will break and thus save wrecking the pumping machinery. The weight of the pinion shaft is carried by a thrust bearing, thus removing this weight from the thrust bearing of the motor.

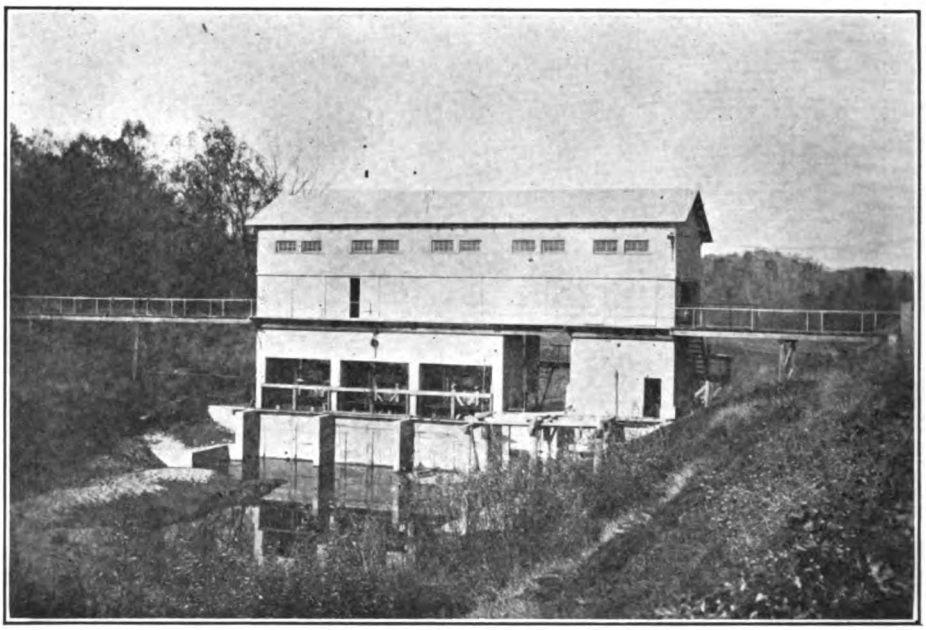


FIG. 2. GENERAL VIEW OF PUMPING PLANT.

The efficiency of the plant, on official test, was found to be much better than 50% at the most economical pumping speed for each head, and it was also found that the plant was very sensitive to fluctuation in head.

The plant consists of four units, three being driven by vertical motors, as noted above, the fourth being driven

Generated on 2024-09-30 00:21 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

by a horizontal motor belted to a bevel gear which drives the pump. The bevel gear installation was the first one made, but it was found that gearing did not stand the strain as well as the vertical outfit, consequently the company is planning to discontinue the use of the belted outfit and replace it with a vertical motor. The capacity of each unit it 225 second feet, making a total plant capacity for the entire unit of 900 second feet.

taken from a bank of three 400-kva. transformers on the Northern California Power Co.'s circuit. These transformers step the voltage from 60,000 volts Y to 2200 volts delta, which feeds direct to the motor.

One of the most interesting features of this installation is the large area which will be put under irrigation with a relatively small amount of power. The ultimate project of the Sacramento Valley Irrigation Co. comprises about

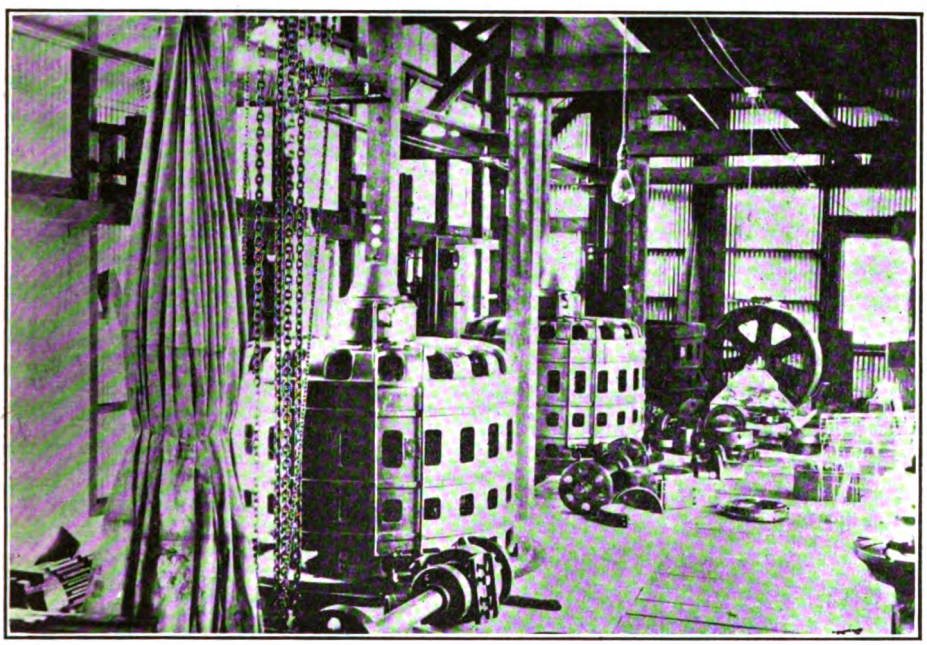


FIG. 3. INTERIOR VIEW OF PLANT, SHOWING MOTORS.

Fig. 3 shows the arrangement of the vertical motors, the No. 3 unit being dismantled at the time the photograph was taken, for the purpose of overhauling the thrust bearing of the pinion shaft. This illustration also shows the class of control used on these motors. Each is controlled by a separate auto-starter panel on which is mounted an ammeter to indicate the load carried by each unit. These motors are fed from a central bus,

250,000 acres. At the present time the company has leveled, checked, and placed on the market about 60,000 acres. The plant of the three units as now installed is estimated to handle better than 150,000 acres, and combining this with the fourth unit and centrifugal pump, they expect to be able to handle the total acreage.

The land under this irrigation project was originally used for raising grain and was held at an average value of

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

about $40 per acre. At the present time this land, when placed under irrigation, is rated from $175 to $250 per acre. This land is being divided into small holdings of from 10 to 40 acres, which would indicate that when the project is fully developed the population will be increased to about 10,000 people.

The principal product of the small farmers in this section is alfalfa, which is utilized for hay, and sold either to the wholesaler in the larger cities, or is used in raising cows for dairy purposes. In addition to this, there is a large number of small chicken ranches. Many farmers raise hogs and sheep for the local market.

The Irrigation company takes care of the larger development, such as planting large acreages of citrus and deciduous fruits. The company has selected the most suitable point for its fruit-growing operations. At present these are divided into three units. The first unit, nearest the Head Gate, is what is known as the Hamilton orchard and consists of a tract of 4000 acres. This tract is being planted with oranges exclusively, and at the present time there is about 1000 acres under cultivation, and the trees are doing exceptionally well.

The second tract is what is known as the Monroeville tract and is planted with deciduous fruit. This tract includes 1200 acres, 600 acres of which has already been planted in different classes of deciduous fruits, such as peaches, pears, plums, apricots, prunes, and a small acreage also of almonds and walnuts.

The third tract is what is known as the James Mills Orchard tract, situated in the foothills back of Maxwell. This tract consists of 10,000 acres of foothill land, which, before the company started its development, was valued at $5 to $6 per acre and was good only for grazing land, and very poor grazing land at that. The value of this land, when developed and the trees are bearing, will increase from $5 to $6 per acre to $1500 to $2000 per acre.

The company has now developed this land and planted about 1000 acres of lemons. As this orchard is in the foothills, a gravity flow cannot be used, so the water is pumped from the canals for irrigation. The irrigation of the Mills Orchard tract is done entirely by pumping plants. The main plant is near the canal, and consists of a 150-hp. motor, direct connected to a 12-in. centrifugal

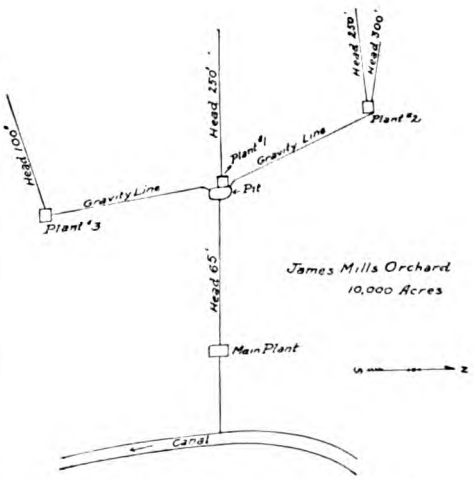
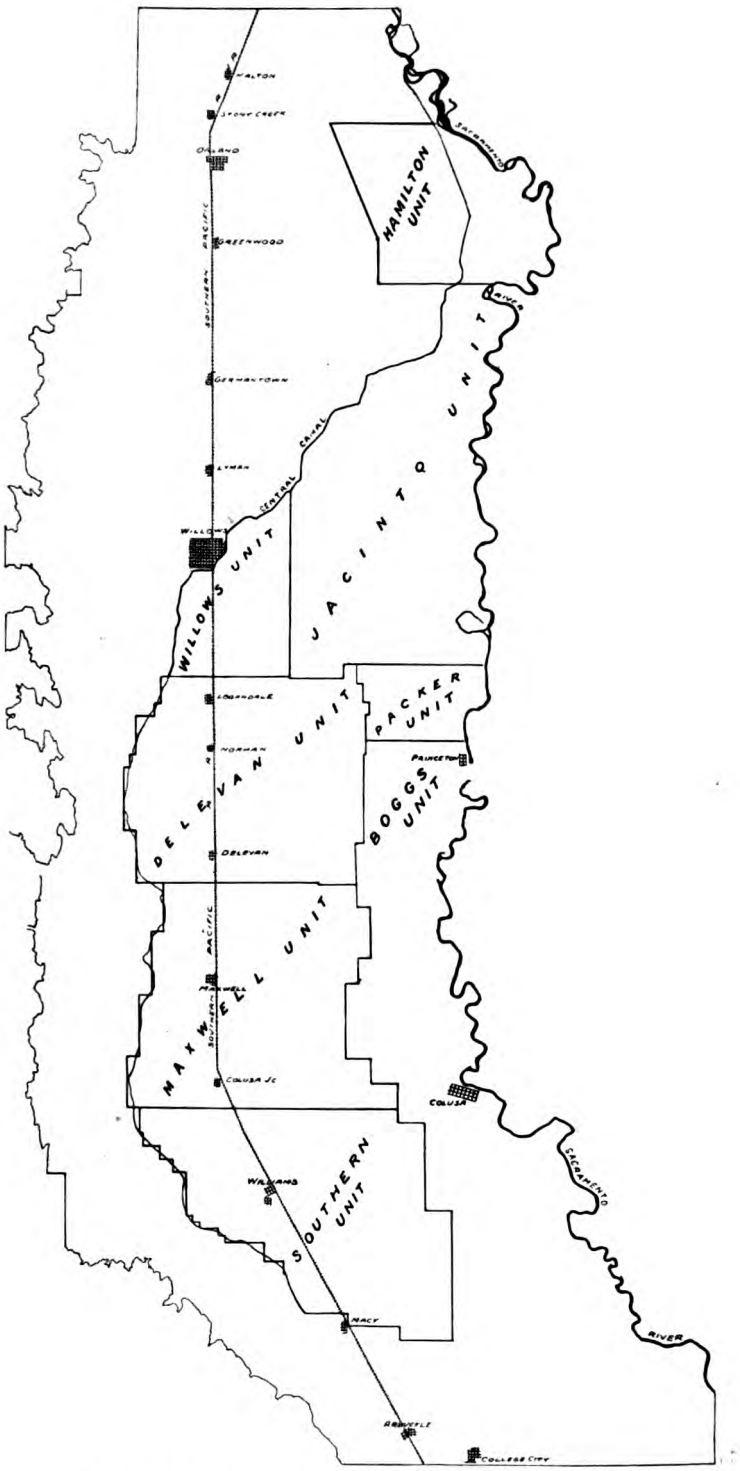


FIG. 4. MAP SHOWING POSITION OF PUMPING PLANTS.

pump. This plant raises the water over a working head of 65 ft., as shown in Fig. 4, to plant No. 1. Gravity lines carry this water to plants No. 2 and 3. Plant No. 2 has two 6-in. two-stage centrifugal pumps direct connected to 100-hp. motors. One works against a 250-ft. head; the second against a 300-ft. head.

In plant No. 1 there are two single-stage 6-in. pumps belted to 50-hp. motors. Each pump is good for 125-ft. head, and, when working in series, an aggregate lift of 250 ft. Plant No. 3 is a single pumping unit, pumping against

Generated on 2024-09-30 00:19 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



MAP OF SACRAMENTO VALLEY IRRIGATION CO. PROJECT.

Generated on 2024-09-30 00:25 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

a 100-ft. head. The pump is 10-in. and is direct connected to 125-hp. motor. The capacity of these plants is now being increased. By the coming spring the main plant will be increased to consist of one 12-in. and one 15-in. unit, and the other plants in proportion, to take care of the additional water.

The water from these plants is handled entirely through piping, it being found that a much more economical distribution could be made in this way than by using the ordinary ditch method. At the present time, the initial unit only, amounting to approximately 450 hp., has been installed. When the whole project is complete at this point they will have installed about 1500 hp. in motor pumps.

To return to the canal construction of this company, starting at the Head Gate plant of the Sacramento river, the canal follows the contour back toward the foothills and passes just east of the town of Willows. Before getting to this point, it is necessary to cross two or three creeks, which is done in different ways. In one case, the canal is carried by a concrete flume over the creek, and in the second case is carried under the creek. On arriving at the Southern Pacific railroad, the canal is taken beneath the track through a flume constructed of reinforced concrete.

After passing Willows, the canal turns back toward the foothills, following as closely as possible the same contour and passing about 4 miles back of Maxwell. It then turns down near to the town of Williams, passes to the north of Arbuckle, and stops nearly directly north of College City.

This project not only considers the development of the better classes of land in Colusa and Glenn counties, but also takes in a large amount of what is known as 'goose' land, or land that is heavy in alkali. It will be a large engineering feat to reclaim this part of the land and make it salable. At the present time the engineers have under consideration the best method of handling this part of the project. Some of this land may be reclaimed by sub-soiling. It will be necessary to tile and drain the balance. It is estimated that the worst of the land can be reclaimed and placed on the market in two years from the time this part of the work is started.

The Trona Railway

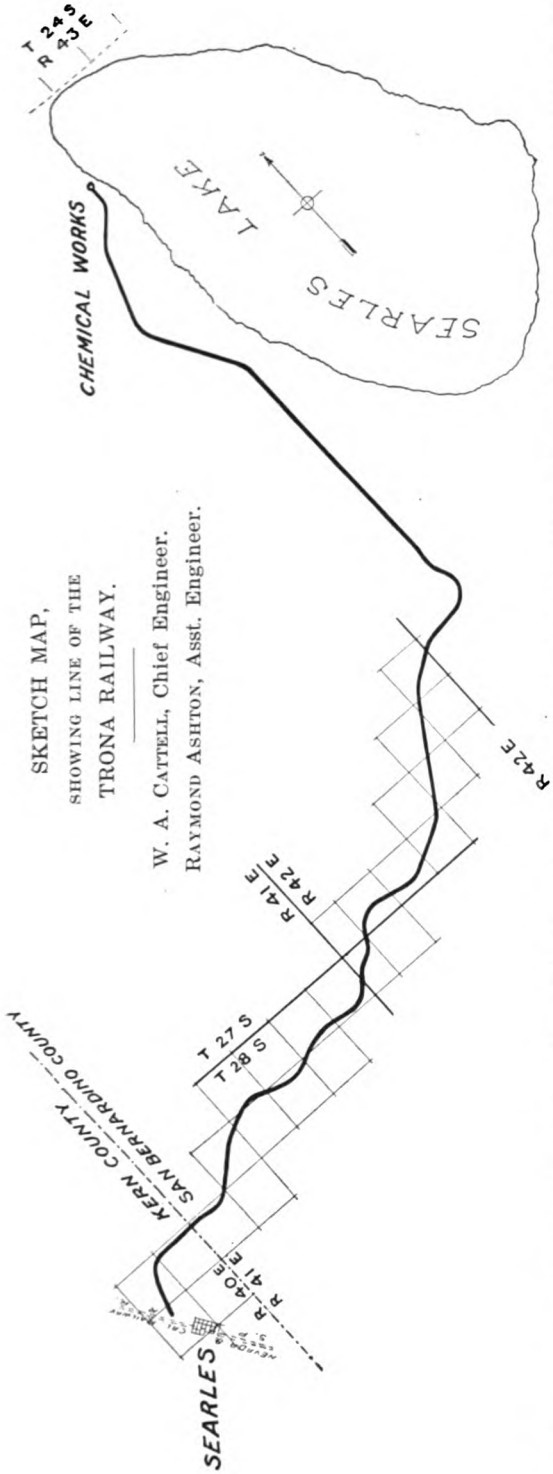
By RAYMOND ASHTON *

IT IS seldom that the construction of a short section of desert railway offers anything of more than passing interest for the railway engineer, but in the construction, soon to be commenced, of the Trona railway, to reach the vast potash and borax deposits at Searles lake, some interesting features are involved.

Searles lake is named after its discoverer, John W. Searles, one of the noted mining pioneers of California. It is situated in San Bernardino county, California, almost in the centre of

*Civil Engineer, Foxcroft Bdg., San Francisco.

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



SKETCH MAP,
SHOWING LINE OF THE
TRONA RAILWAY.
W. A. CATTELL, Chief Engineer.
RAYMOND ASHTON, Asst. Engineer.

the Mojave desert, about 80 miles northeast of the town of Mojave, and 50 miles south of Death Valley. It lies in an irregular-shaped basin, bounded on the east by the Slate range, a spur of the Panamint range, and on the west by the Argus mountains.

The recent discovery that the lake contained large and valuable deposits of potash, as well as borax, soda, and other alkalis, which had long been known to exist at this point, led the owners of the property to prepare plans for the erection, on the shores of the lake, of a large plant for the manufacture of potash, borax, soda-ash, and other alkali products. This plant, when fully developed, will become one of the largest of its kind in the world. The detailed plans, which have been prepared by John W. Hornsey, of New York City, contemplate the installation of four complete units, each with a capacity of 750 tons per day, so that the ultimate output of the completed plant will be 3000 tons daily. To bring this product to the existing transportation systems, as well as to carry to the lake the machinery and building materials necessary for the construction of the plant and the industrial village which will be established in connection with it, necessitates the construction of the Trona railway.

Several routes for the proposed railway were considered, but the most practicable was found to be from a point at or near Searles station, on the Nevada & California railway, the Owens Valley branch of the Southern Pacific system, 50 miles by rail northeast of Mojave.

The lake is about 25 miles in a direct line northeast of Searles station. Intervening between the two points is a range of hills rising to a maximum height of some 4000 ft. above sea-level, around which it was necessary to make

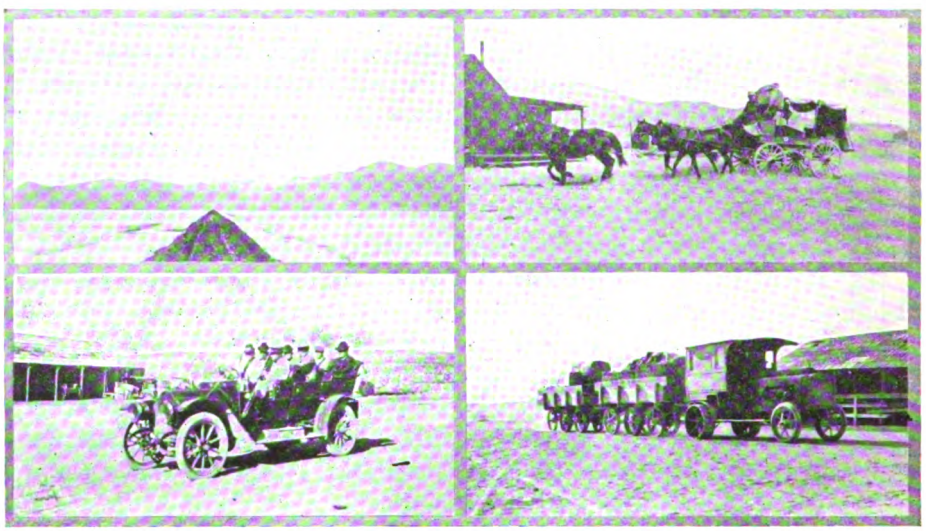
Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

a considerable detour, thus requiring a total length of 31 miles of line to reach the site of the proposed chemical works. Searles station is 3250 ft. above sea-level, while the lake is but 1650 ft., a total difference in elevation of 1600 feet.

The broad open valley, lying south of the range of hills already referred to, slopes to the east with a fall of approximately 110 ft. to the mile. A line located on the floor of this valley could have been constructed with very light grading, but it would have necessitated the use of a maximum grade slightly in excess of 2%. As the maximum grade on the Southern Pacific system, between Searles station and tidewater, was 1.75%, it was thought advisable to make this the maximum limit for the line to the lake.

It required considerable study and the running of numerous survey lines, to cross the valley at Searles station and find a location on the northerly slope of the valley, from which the descent could be made on a 1.75% compensated gradient and without encountering excessive grading. This was finally accomplished, however, and the line located within the maximum, with light grading and easy curvature.

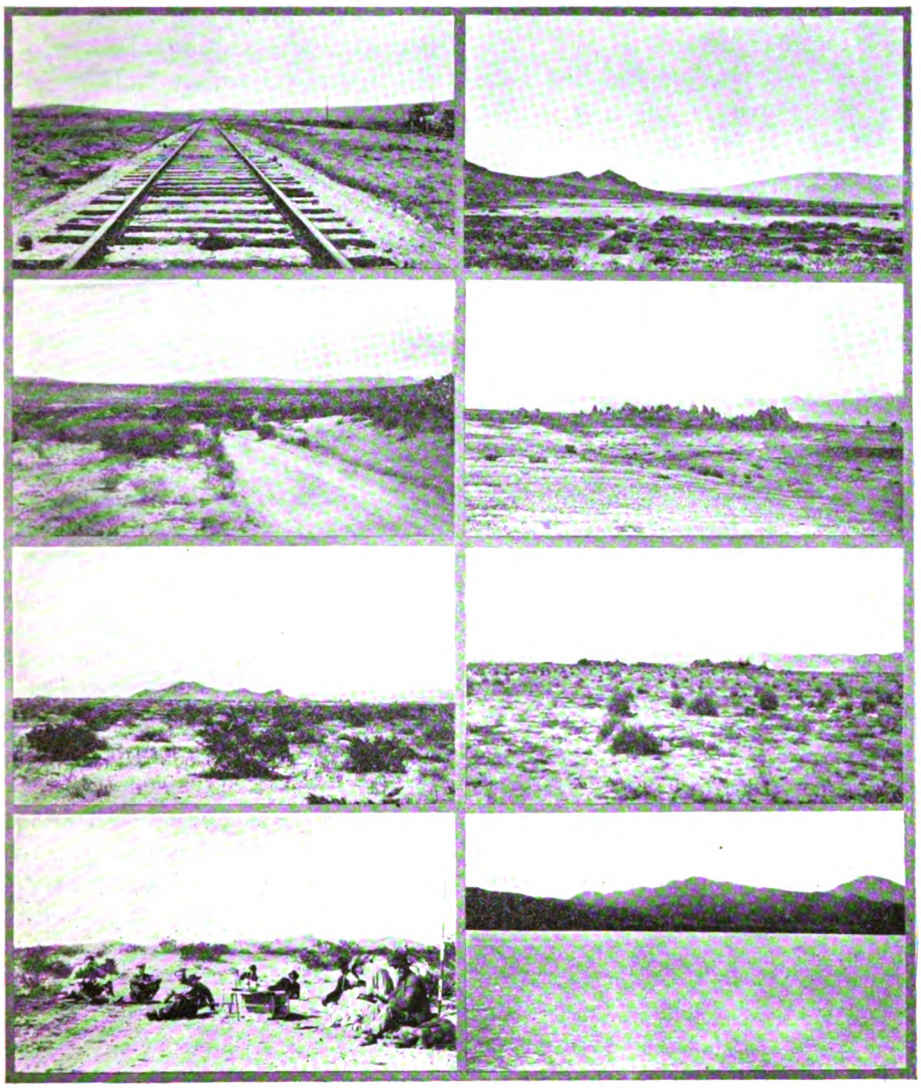
After leaving what will be the yard limits at Searles station, the maximum grade, broken only by the compensation for curvature (which is at the rate of 0.035% per degree), is maintained for 11.40 miles, the total drop in this distance being 1030 ft. From this point to the end of the line various grades are used, though the maximum 1.75% is nowhere exceeded. For many miles, particularly along the shores of the lake, the track will be on a dead level or on grades so light that they may be neglected as a consideration in the handling of traffic. Compensation for curvature might also have been neglected altogether, as the sharpest curve used on the entire line is only



PRESENT TRANSPORTATION.

(1) Road across north end of Searles lake.
(2) Locating party leaving camp.
(3) The Johannesburg-Ballarat stage at Searles lake.
(4) Renard train hauling supplies to present chemical works at Searles lake.

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



VIEWS ALONG THE LINE OF THE TRONA RAILWAY.

(1) The Nevada & California railway at Searles station.
(2) The Johannesburg-Ballarat stage road, one mile east of Searles station.
(3) Typical desert scenery.
(4) The 'located' lunch box.
(5) Approaching the pinnacles.
(6) The pinnacles.
(7) Distant view of present chemical works.
(8) Searles lake; Argus mountains in the distance.

2 degrees. Even the general change of direction, made in rounding the point of the range of hills jutting out into the southerly portion of the lake, and which necessitated a total deflection angle of 115° was made with a simple continuous 2° curve.

This curve, which occurs about 18 miles east of Searles station, is through a rugged formation of sharply pointed outcroppings of calcium carbonate, locally known as the 'Pinnacles,' and which in the twilight or under the influence of the noonday mirage, are converted, with little stretch of the imagination, into the spires and min-

Generated on 2024-09-30 00:19 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

arets of an Oriental city, or the ruins of an Inca stronghold.

From the 'Pinnacles' the line runs almost due north to the site of the chemical works, for the most part, as has been noted, with level or very light grades, but cutting at one point through an old lake shore dike composed of the finest quality of gravel for ballast, and at another, through a narrow ridge of granite and basalt rock.

At the terminal the ground rises above the general level of the lake sufficiently to give ideal grades for the installation of gravity switching yards, and all trains leaving the plant will start off down-hill.

In order to handle properly the large volume of traffic for the chemical works, as well as that which will result from the development of this region incident to its being supplied with transportation, fairly heavy construction will be required. The railway will be of standard gauge, and the track will be laid with 80-lb. rails on standard 7 in. by 9 in. by 8 ft. ties, while all bridges will be designed to carry a locomotive similar in type to the heavy consolidation-locomotives now in use on the mountain divisions of the larger Pacific Coast railways, approximately 200 tons in weight, followed by a train of standard ore-cars, each of 100,000 lb. capacity.

Although there are no difficult engineering problems involved in the construction of this road, the provisions which must be made at several points to protect the roadbed against possible damage from cloudbursts have received very careful study. In the vicinity of the 'Pinnacles,' and to some extent all along the shores of the lake, the evidences of recent and violent cloudbursts are everywhere apparent.

Corrugated-iron drain pipes of large diameter, with concrete end-walls placed at frequent intervals, will provide for the drainage from Searles to the 'Pinnacles,' but at the 'Pinnacles' and in the long shallow embankments along the shores of the lake, it will be necessary to build several hundred feet of reinforced concrete trestle to provide for the passage of the volume of water which must suddenly run off into the lake after the occurrence of a cloudburst in the adjacent hills. A large amount of rip-rap will be required for the protection of these embankments, but this can be obtained readily and at small cost from the ledges of granite and trap rock which at several points lie close to the line.

For the most part, the railway passes through a country requiring comparatively light grading, and the material encountered is generally a disintegrated granite mixed with a small portion of clay which makes excellent ballast. As the contract for grading is to be let without classification, test pits were dug in every cut of any depth, and it was found that very little rock will be encountered. The construction of the roadbed will involve the moving of approximately 600,000 yd. of material, most of which will be scraper work.

An interesting feature connected with the surveys for the line was the use which was made of the automobile. In addition to the regular line-wagon drawn by horses, the locating party was provided with a seven-seated touring car, which it was found could readily carry ten men. There are few places along the route of the railway where an automobile cannot be driven close to the line, and as it was necessary for the party to make the entire survey from two camps, one at either end of the line, on account of the scarcity of water at intervening points, the sav-

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ing of time in getting the party to and from work was really remarkable. It is estimated that the saving thus effected would more than pay the entire cost of the car, purchase price and maintenance, even for so short a line as that of the Trona railway.

Searles lake itself is an extensive crystalline deposit of potash, borax soda, and other alkalis, formed by the evaporation of the waters of what once constituted a vast inland lake, some 200 square miles in area. The former water-level of this lake is known to have been about 600 ft. above the present crystalline surface, as evidenced by the water lines on the mountains.

The precipitation over the entire desert region in which the lake is situated is now extremely light, and as the rate of evaporation is high, the solid crystalline surface of the lake is dry throughout the greater part of the year, and is in reality a far-reaching, dazzling plain of the whitest salt. The streams draining into the lake show no surface flow except during the rainy season, when the lake is at times covered with water to a depth of a few inches only. The most concentrated portion of the deposit covers about 40,000 acres in the centre of the basin, and is about 70 ft. in depth.

The general method of operation proposed is to pump the brine from numerous wells scattered over this area, through pipes into the chemical works, which will be established on the shores of the lake. Here the various products and by-products will be separated and converted into commercial form, and shipped out over the Trona railway.

The general route of the railway was selected and the line located under the personal direction of W. A. Cattell, C.E., Consulting Engineer of San Francisco, and the road will be constructed under his supervision.

Concrete Socket Piling

By K. D. MacLEAN*

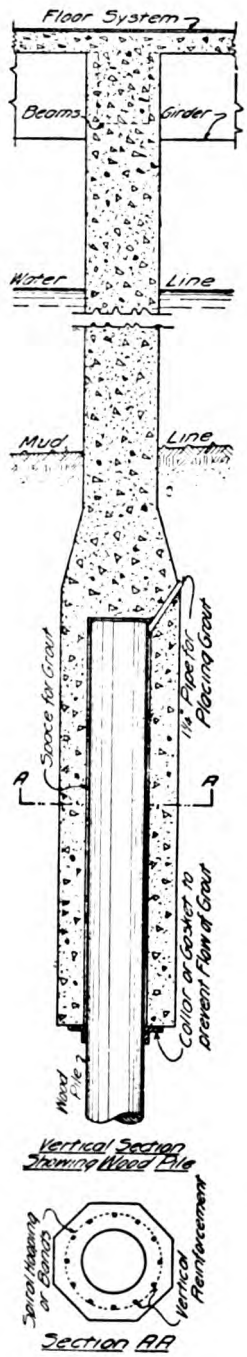
NATURAL conditions in most American harbors make the pier-type of construction the most feasible method of providing berthing facilities for ships. The dimensions of these piers depend upon local conditions and demands, the length being limited by federal regulations, the width largely depending upon the method of cargo handling and whether or not the pier must be used as a temporary warehouse during the loading and discharging of cargo. The most important question in all construction work is the foundation, and this is particularly true in marine construction. The most common types of pier substructure construction are: (1) wooden piling; (2) protected piling, including creosoted wood piles, wrapped piles, and concreted protected piles, both single and clustered in cylinders; (3) piers or cylinders set on hard bottom and on piling, and

*Formerly Superintendent of Construction and Repair, Board of State Harbor Commissioners, San Francisco.

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

(4) concrete piles, made in place and pre-cast.

In salt water, a peculiar condition created by the existence of marine insects, the teredo, xylotrya, and limnoria, that attack and destroy wood, must be met in foundation construction. As the action of these insects limits the life of a wooden pile to four months to two years, this type of construction is useless except for merely temporary work. From the standpoint of initial cost, after green wooden piling comes poison-protected piles, of which the creosoted pile is the best known form. The treatments protect a pile for a certain length of time, but the final result is the same. For the above types of substructure, only a wooden superstructure is possible, which is subject to great fire risk.



CONCRETE SOCKET PILE.

Concrete-Protected Wooden Piles: Single Pile.—In this type, the load is carried upon the wooden pile, the concrete being but a thin shell to protect it from marine-insect attack. This thin shell is hard to place properly, and is liable to crack and break off, allowing the teredo easy access. The mud line, where protection is most needed, is the point where faulty construction is most liable to occur. It is hard to place this protection at a sufficient distance below the mud line to provide for a future increase of depth of water demanded by ships of greater draught.

Clustered in Cylinders.—I wish to make a distinction between this type and cylinders on piling. In the former type the piles are carried up to or nearly to the girders, while in the latter they are cut off below the mud line. This type is more expensive than any yet mentioned, and is subject to all the possibilities of faulty construction in pouring concrete in sea water, and particularly at the mud line where protection is most needed. In both of the foregoing types these faults may exist without being detected, due to the impossibility of inspection. In

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

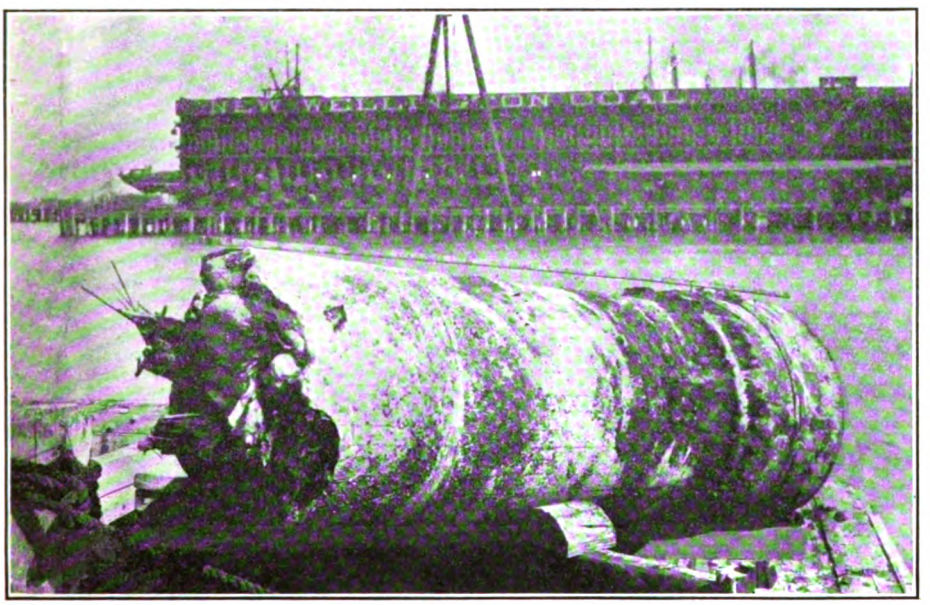
San Francisco harbor many piers have been built by this method and practically all of them are now going to pieces after but a few years use.

Piers or Cylinders.—On hard bottom this type is first-class construction, limited, however, by the necessity of providing suitable bottom at not too great a depth, and by its high initial cost.

On Piling.—This also is a good but expensive type of construction when hard bottom is not available at reasonable depth, providing that the work is done in the dry, namely, by means of a coffer-dam.

Concrete Piling: Made in Place.—In any type of made-in-place piles there are almost sure to be unavoidable and unknown points of faulty construction. This is particularly true in marine work. There are numerous chances for this, such as a movement of reinforcing material; separation of component parts of concrete; effect of salt water on freshly poured concrete; imperfect cleaning of mud from shell; clogging of rocks between shell and reinforcing, causing large voids and thereby making the pile useless. Any or all of these may happen and still remain undetected on account of the impossibility of inspection.

Pre-cast Piles.—For permanent construction at a reasonable cost, this is the ideal type. Every pile is known to be perfect and cured before being placed. It is immune from decay, fire, or marine-insect attack, and will carry a wood, steel, or reinforced-concrete superstructure. It has, however, one very serious limitation, namely, length. On account of its weight and small cross-section, it is difficult, and after certain limits impossible, to move and raise it from a horizontal to a vertical position, and so has only been used in shallow mud and water as in bulkhead construction. To remedy this defect, a type of substructure construction has



RESULT OF FAULTY CONSTRUCTION IN CONCRETE PROTECTED WOODEN PILE.

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

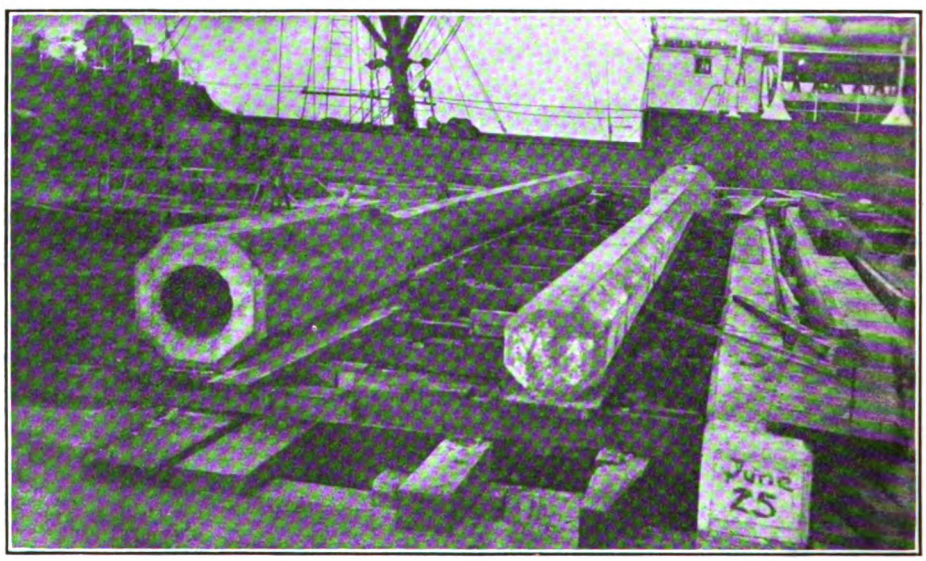
been devised with all the good features of the full-length pre-cast pile, without its limitations, and can be built at much less cost. This has been patented and is called the socket pile.

The pile, as shown, is of reinforced concrete, molded on the ground in either steel or wooden forms prior to driving. It is fitted on the end with a socket for superimposing upon a wooden-pile foundation or base, as shown. The dimensions of the various sections are shown in the following report on tests.

By this method is obtained a solid concrete construction, from a short distance below the mud-line upward, or in all sections which are liable to decay, to attack by marine insects, or fire.

As the wooden pile is practically everlasting below the mud, this gives a cheap and easily handled type of construction, particularly adapted to deep mud localities, where the extreme length of concrete piling of the ordinary type prohibits its use. The cost is much less than that of any other possible form of concrete construction and compares favorably, even in first cost, with temporary creosoted wood-pile construction. When the repair cost of the two types is considered, no comparison can be made.

The soundings are first made in the mud in the usual manner, and the length of wooden pile computed so that its top, when driven, will be a foot or two below the mud-line. It is then driven to within a short distance of the water-line, and at a point near where the bottom of the socket will come, a collar is placed around it (burlap has proved very satisfactory). The socket pile is then placed over the wooden one and held up about 6 in. while all the space in the socket not occupied by wood is filled with grout through the small pipe shown, which is then capped and the socket pile dropped to place, forcing, under great pressure, the extra grout into all voids. The combined pile is then driven to place. That this joint, after setting, has more strength than any other



CONCRETE SOCKET PILE READY FOR USE.

Generated on 2024-09-30 00:20 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

section of the pile is proved in the accompanying tests. On account of its short length, it is easily and cheaply handled.

Any type of superstructure can be used, and even for wooden piers this method of construction is cheaper and more efficient than concrete-protected wooden piles.

Tests of Piles, January 30-31, 1913.

Location of Test.—Made by Board of State Harbor Commissioners at Howard street pier No. 6; north side of pier about 100 ft. out from bulkhead line; floor of dock about 20 ft. above mud-line.

Pile No. 1, Wooden Pile.—Length, 40 ft.; diameter butt, 17 in.; diameter tip, 12 inches.

Upper 6 ft. of pile trimmed to 13-in. diameter to fit socket of concrete pile and give about ½-in. play.

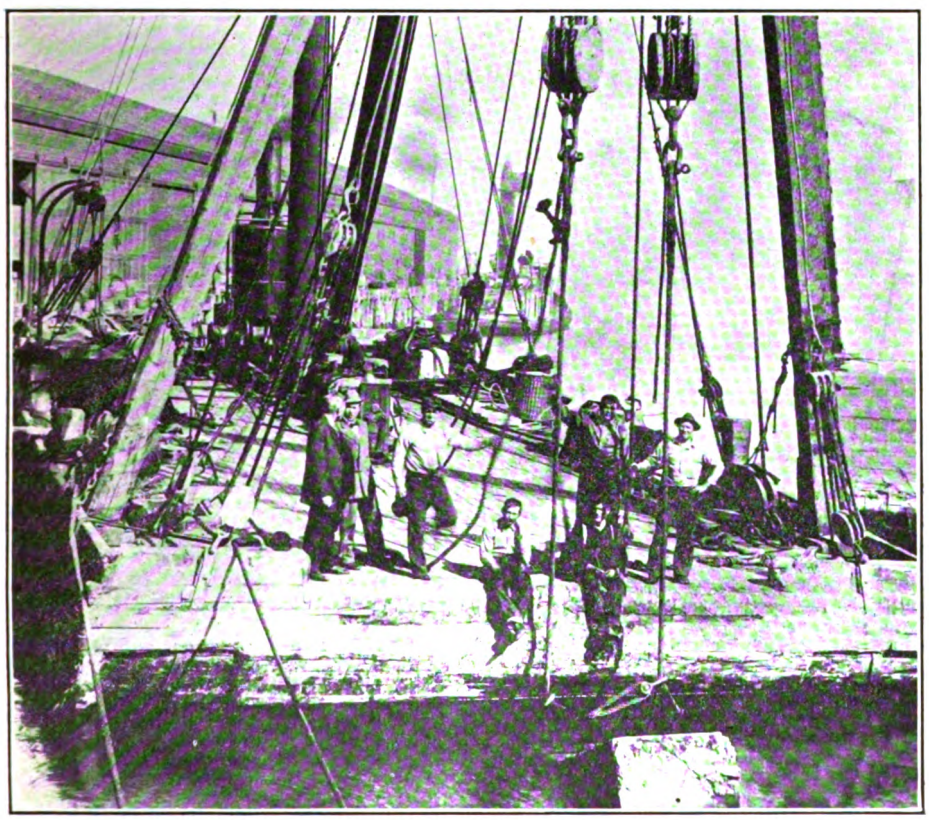
The wooden pile was driven until the top was about 6 ft. below floor of dock before socket pile was set upon it.

Socket Pile (Concrete), Octagon Section.—Total length of concrete pile, 40 ft.; length of shaft, 34 ft.; depth of socket, 6 ft.; diameter of socket, 14 in.; thickness of socket wall, 8 in.; diameter of shaft, 16 inches.

Reinforcing: eight 1-in. corrugated bars wrapped with No. 3 annealed wire; socket wrapped on 3-in. pitch and shaft on 6-in. pitch.

Concrete 1:2:4 mixture, Mt. Diablo cement, Niles sand and gravel graded 1 in. down. Weight, about 5½ tons.

Pile was driven with Arnott No. 1



REMOVING DESTROYED CONCRETE PIER FROM SLIP 5, OCTOBER 31, 1911.

Generated on 2024-09-30 00:22 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

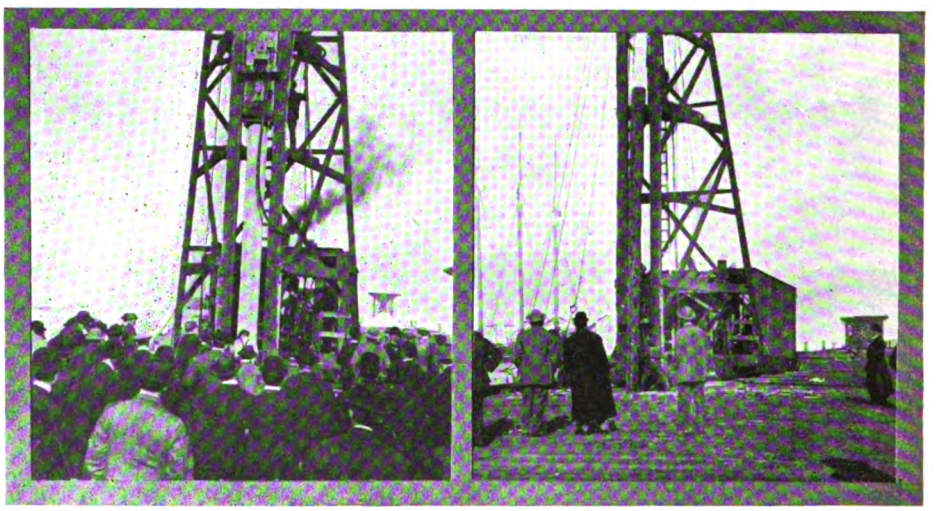
hammer, made by the Union Iron Works of New Jersey, and delivering 1,100,000 ft.-lb. per minute at 110 blows. Hammer was working at about 117 blows per minute.

Total number of blows, 275; total penetration under 275 blows, 22 ft.; average penetration per blow, 11/12 in.; average penetration per blow for last 2 ft., ½ in.; total penetration of tip of wooden pile, 48 feet.

A 2-in. wooden cushion was used in driving, which broke, and a portion of the driving was carried on the bare head of the pile. Also, the pile was not square under the hammer, so the concrete was broken and reinforcing bent for about 1 ft. around the head of the pile. The socket pile was then pulled and found in perfect condition, except for destruction of the head as above mentioned.

Pile No. 2, Wooden Pile.—Length, 45 ft.; diameter butt, 16 in.; diameter tip, 11 in. Upper 6 ft. trimmed as pile No. 1.

The wooden pile was driven until the top was about 7 ft. above the floor of the dock and left in place from 4:30 p.m. until 8:30 a.m. the next day before driving was continued. The socket pile rested upon the wooden pile over night. Before the driving was resumed, the socket pile was raised about 6 in. and the space was filled with grout through the pipe provided for the purpose, the pipe capped, and the socket pile lowered, forcing grout into all spaces in the socket not occupied by the wooden pile, the latter having been wrapped with burlap near the bottom of the socket to prevent the escape of the grout.



DRIVING CONCRETE SOCKET PILE.

Socket Pile (Concrete).—Same as No. 1, except thickness of socket walls was 6 in. Reinforcing: twelve ⅝-in. corrugated bars, wrapped same as No. 1. Weight, about 5 tons. Driving hammer same as No. 1.

Total number of blows on concrete pile, 1143; first 30 blows caused penetration of 1 ft., average 2/5 in. per blow; next 23 blows caused penetration of 18 ft., average 9⅓ in. per blow; next 27 blows caused penetration of 12 ft., average 5⅓ in. per blow; next 110

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

blows caused penetration of 8 ft., average 7/8 in. per blow; next 953 blows caused penetration of 4 ft. to refusal. Total penetration of pile (wooden tip), 61 feet.

Continuation of Tests, Feb. 28, 1913.

On this date an attempt was made to pull up pile No. 2 in order to test the efficiency of the method of joining the concrete and wooden portion of the pile. State pile-driver No. 1 was used, being equipped with an 8¼ by 10-in. double-cylinder triple-drum engine. The pile was slung with a 1½-in. staggered chain with a 4-in. hook, and the line from this passed through a pair of 3-sheave blocks, thence to the hook of a single block in the bight of the engine runner, one end of which runner was fastened to head-block of driver. The mud was then loosened around the socket of the pile by means of a 2-in. jet, and over an hour was spent with the purchase above described, to pull the concrete pile off the wooden one.

When this attempt was found to be unsuccessful, a floating driver was brought alongside, and with the two machines the pile was pulled forward and backward through an arc of about 110°, to see if it would be fractured in the socket, thereby breaking the adhesion. The pile evidently broke 2 or 3 ft. above the socket, and with no injury to the socket, as a second attempt to pull it proved no more successful than the first. The pile still remains where driven.

This test was the most severe possible, and it proved without a doubt that the socket can be depended upon for at least as great an efficiency as the ordinary and well known type of concrete pile.

The following shows the comparative cost of a full-length concrete pile and a socket pile under the same conditions.

The condition taken, an average one, assumes an 80-ft. pile and an average distance throughout the wharf of 35 ft. from bottom of girder to mud-line. This will allow under average condition for 40 ft. of water along the fender line.

Full length 80 ft., $100 per pile, or $1.25 per lineal foot.

Socket pile, $65 per pile, or 81c. per lineal foot.

This is cost in place. Stripping reinforcement to bend into beams, a small item, is the same in both cases.

I wish to draw attention to a valuable feature of the socket pile used in repair work on existing structures. The socket pile can be used for repair work anywhere a wooden pile can be placed, and, when driven, ends replacement of that particular pile forever, so that when the annual repairs are made according to this system there comes a time when the repair bills for the substructure will cease and the wooden deck can be ripped off and replaced with one of concrete or steel, thereby providing a modern dock, fire, decay, and teredo-proof, at practically no more than repair cost. This feature is not possible by the use of any type of concrete-protected wooden piles.

This pile costs less, per lineal foot of pile or per square foot of dock surface, than any other form of permanent substructure construction. Allowance can easily be made by driving down the concrete section for future increase of depth of water necessitated by the advent of vessels of greater draught.

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

Centrifugal Pumps for Irrigation

By C. F. BRAUN*

CENTRIFUGAL pump design has in recent years made such rapid progress that the characteristics and capabilities of the modern machine are not thoroughly understood by the majority of engineers, and much less so by purchasers.

This lack of information on the part of purchasers has afforded the opportunity for the manufacture and sale of a great many pumps by small shops who have neither the designing ability necessary for the hydraulic problem of the pump passages, nor the machine tools required to make a mechanically fit apparatus.

Such pumps built and installed without regard to conditions or requirements have in most cases given much trouble mechanically and on account of improper design, or rather lack of design, of the pump passages, have required large power for operation.

The result is that among the majority, irrigation by pumping is regarded as an exceedingly expensive process, and a heavy premium is placed on lands having ditch-rights insuring water at prices ranging from 50c. to $4 per acre foot.

It is the purpose of this article to point out a few features, which, if carefully regarded, make the centrifugal pump a highly efficient, very reliable unit, capable of delivering water at surprisingly low cost, and of competing with gravity canal-systems.

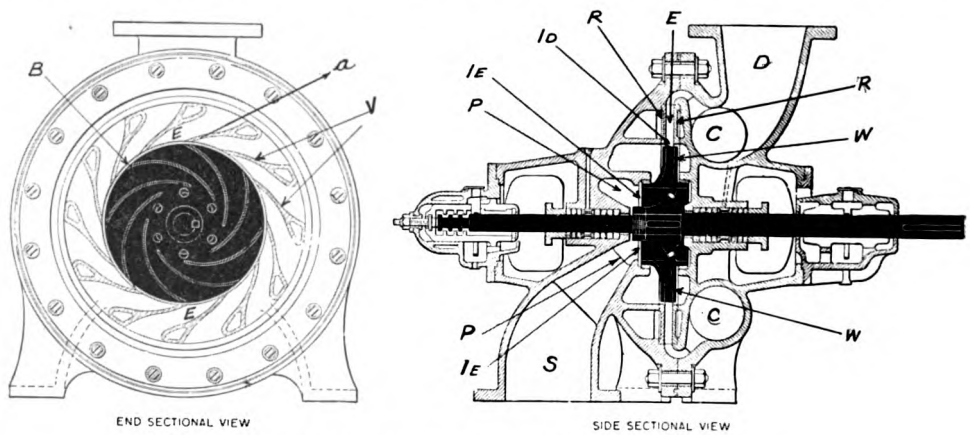


FIG. 1. SINGLE-STAGE TURBINE PUMP. VERTICALLY SPLIT CASE.

Centrifugal pumps are generally divided into two classes, known as turbine and volute, based upon the type of the stationary water-passages.

Turbine Pump.—Fig. 1 shows a sec-

*Hooker and Lent Bdg., San Francisco.

Generated on 2024-09-30 00:22 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

tional view of a modern high-grade turbine pump. The course of the water is clearly indicated by arrows, but a brief description will be of assistance. Water enters the suction passage *S*, filling the annular suction chamber *P* and flowing freely to the impeller entrance *Ie* at all parts of its circumference. The impeller is constructed with walls *W*, between which are blades *B*. This impeller is rotated, causing the water, by reason of the blades *B*, to rotate with it. The water by centrifugal force flows to the outer edge of the impeller *Id*, which it leaves with high velocity,

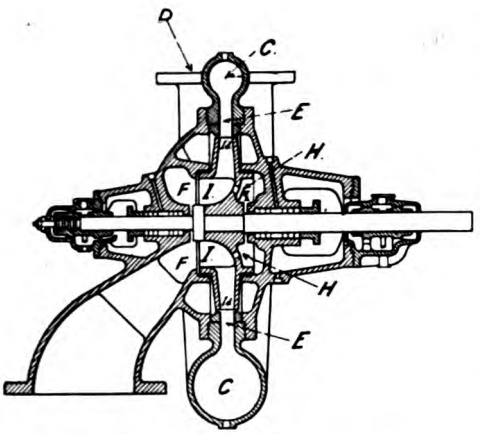


FIG. 2. STANDARD VOLUTE PUMP.

in a direction somewhat as shown by arrow *a*.

In order to complete its work, the pump must reduce the velocity of this water, converting the velocity-energy into pressure-energy. Diffusion vanes *V*, secured between diffusion rings *R*, form a number of water passages increasing in area and gradually changing in direction. The water flowing at high velocity from the impeller enters the passages *E*, where its velocity is gradually reduced and its direction slowly changed by the vanes, so that it is discharged radially into the collecting chambers *C* with low velocity, most of the velocity energy having been converted into pressure-energy. The discharge outlet *D* is placed at some convenient point on the collecting chamber.

The turbine pump derives its name from the diffusion vanes because of their similarity to the vanes of a water or steam turbine.

Volute Pump.—Fig. 2 shows a sectional view of a volute pump. The action of this pump is similar to that of the turbine pump, but the water leaving the impeller at *Id* is not guided by vanes, but must find its own direction through the open passages *E* to the collecting chamber *C*. This chamber increases in size gradually around the circumference to the discharge connection *D*, so that the velocity of the water is reduced and velocity-energy converted into pressure-energy.

The volute pump derives its name from the spiral of volute shape of the collecting chamber.

Multi-Stage Pump.—The head or lift under which a single-stage centrifugal pump may be designed to operate is limited, by considerations of efficiency and wear, to about 150 ft. If much greater heads are attempted, the velocity of the water leaving the impeller will be so great as to cause large friction loss and consequent low efficiency, and will give rise to excessive wear.

Two or more pumps, however, may be operated in series to give any head desired. A multi-stage pump is essentially several pumps constructed as compactly as possible, and having a single casing, single shaft, etc., with water passages connecting the discharge from each pump to the suction of the succeeding one.

Fig. 3 shows sectional views of a two-stage turbine pump designed for a total lift of 200 ft. The water enters the first impeller *I* at, say, 300-ft. head, is delivered at *M*, the end of the first

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

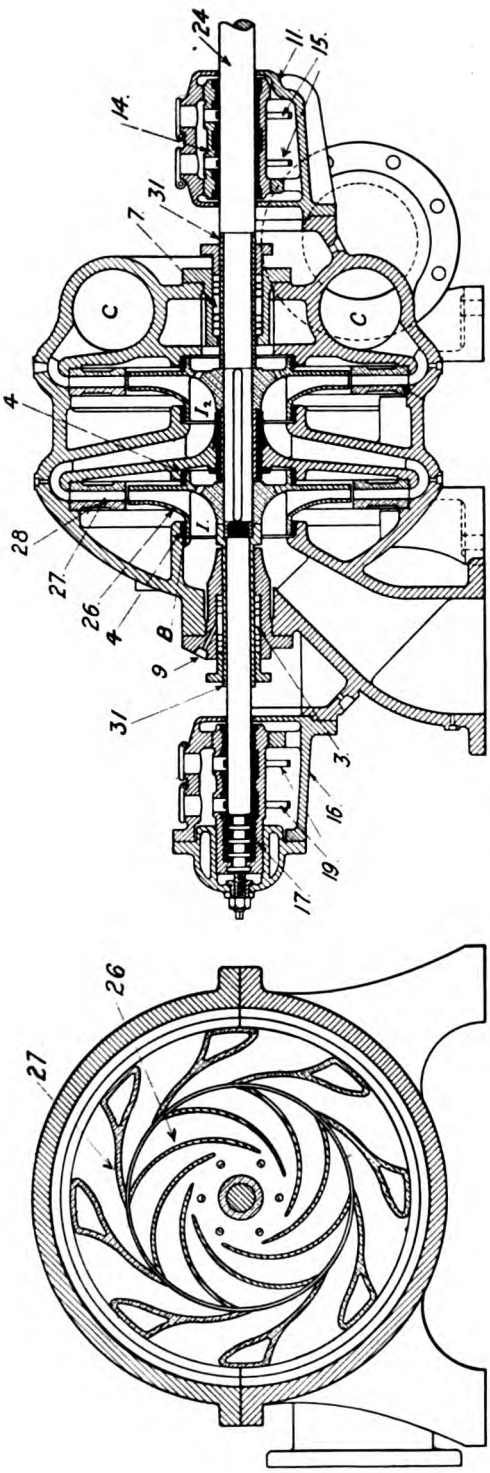


FIG. 3. TWO-STAGE TURBINE PUMPS. HORIZONTALLY SPLIT CASE.

stage, at 100-ft. head, at which head it enters the second impeller I_2, and is discharged at C, the end of the second stage, at an additional head of 100 ft., or a total head of 200 ft. For uniformity of parts, all stages are constructed alike and add equal increments of head.

The amount of head or pressure that any pump or any stage of any pump will produce is independent of the pressure of the water entering. Thus for a pump or stage designed for 100-ft. head, if the entering head is zero the discharge head will be 100 ft., while if the entering head be 50 ft., the discharge will be 150 ft., ad infinitum.

Limitations of the Centrifugal Pump.—Turbine pumps can be used to advantage on heads as low as 50 ft., and by the multiplication of stages, on heads up to 1500 ft. Mechanical considerations limit the number of stages to five, and since the limit of head per stage is about 150 ft. as described above, a single pump can be built for heads not greatly exceeding 150 feet.

Two pumps can be used, one on each side of the driving motor, and the discharge of one pump connected to the suction of the other, so that, in effect, a ten-stage unit can be obtained. Fig. 4 shows such a unit operating in the North Star mines of Grass Valley, California, against a head of 1400 ft., or 600 lb. per square inch.

Volute pumps are suitable for heads ranging from 5 ft. up to 60 to 100 ft. They should not be used for heads much exceeding these, for water-passages without diffusion-vanes are not suitable for high velocities. At high velocities the water flowing to the open collecting chamber without guide vanes, gives rise to currents which are destructive to efficiency. These eddy currents would also cause erosion of the cast iron pump casing, which is an

Generated on 2024-09-30 00:24 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

expensive part to replace. In turbine pumps, any wear that does take place will be on the diffusion vanes, which can, without excessive expense, be made of bronze and which, if necessary, can be easily and cheaply renewed.

Multi-Impeller Pump.—For handling large quantities of water at low heads there has been developed the multi-impeller pump (Fig. 5). This pump consists of three impellers working in parallel in one case, the object being to increase the rotative speed. The permissible speed of a pump for any given head is limited by the impeller diameter *Id*, which in turn is limited by the suction opening required for the volume of water to be handled. By using say three impellers, the volume of water to be handled by each impeller is only one-third of the total, so that the diameter of the impeller suction opening *Ie*, and consequently the peripheral diameter of the impeller, may be reduced.

Furthermore, the weights of parts are reduced, making possible the use of better materials and the greater ease of handling for repair. This type of pump is sure to increase in favor and take an important part in irrigation work, for it makes possible the use of direct-connected units operating at desirable motor speeds.

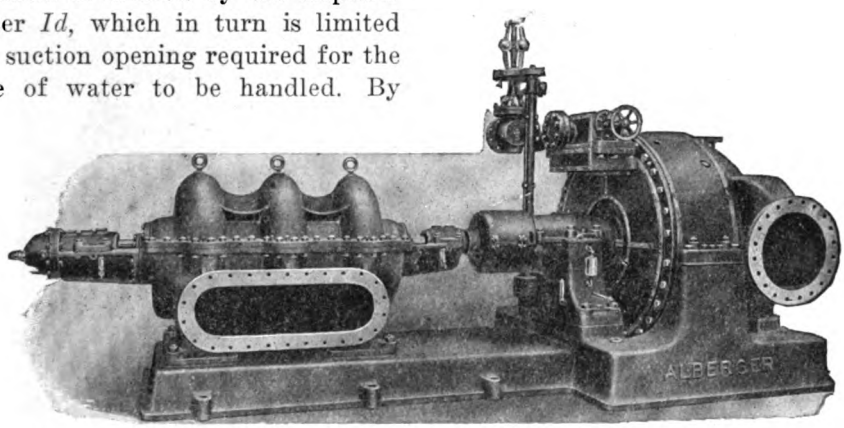


FIG. 5. THREE-IMPELLER HIGH-SPEED VOLUTE PUMP WITH STEAM TURBINE. 15,000 G.P.M., 30-FT. HEAD, 162 BRAKE HORSE-POWER.

Mechanical Details

Impeller.—The impeller (26) should be machined and highly finished all over, and the passages not accessible for machining should be chipped and filed.

The velocities in a centrifugal pump are quite high, and the passages correspondingly small, so that high efficiencies are absolutely impossible with rough water-passages. The impeller must, furthermore, be carefully adjusted for rotative balance, otherwise there is liable to be serious vibration so often found.

Shaft.—The shaft (24), to which the impeller should be securely keyed, should be of liberal size so as not to spring, and should be supported by two bearings (11 and 16), one on each side of the impeller. The practice of overhanging the impeller and supporting the shaft on a single bearing is to be condemned, for in addition to being unfit mechanically, it gives unbalancing and thrust. The shaft should be ground true and round, so as to present a good bearing. Renewable bronze sleeves (31) should invariably

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

cover the shaft where in contact with the water, and should extend well outside of the stuffing-boxes. Corrosion and cutting of the shaft in the stuffing-box is a frequent cause of trouble.

Stuffing-boxes. — The stuffing-boxes (3 and 7), through which the shaft passes, are very important features. They should be of liberal length, so as to contain five or six rings of packing. If the boxes are short, accommodating only a few rings, they will have to be squeezed very tight, causing binding and cutting of the shaft. They should be entirely removed from the stuffing-boxes, so that water cannot possibly reach them. Nearly all water carries some sand and will cut bearings or shaft if allowed to enter. Liberal size oil chambers should be provided below the bearings, and be fitted with gauge-glasses to readily show the oil level. Ring oilers (15 and 19), carefully designed so as not to stick, should carry the oil to the bearings. Above all, they should have renewable cast iron split bushings (14 and 17) which can be easily removed and rebabbitted

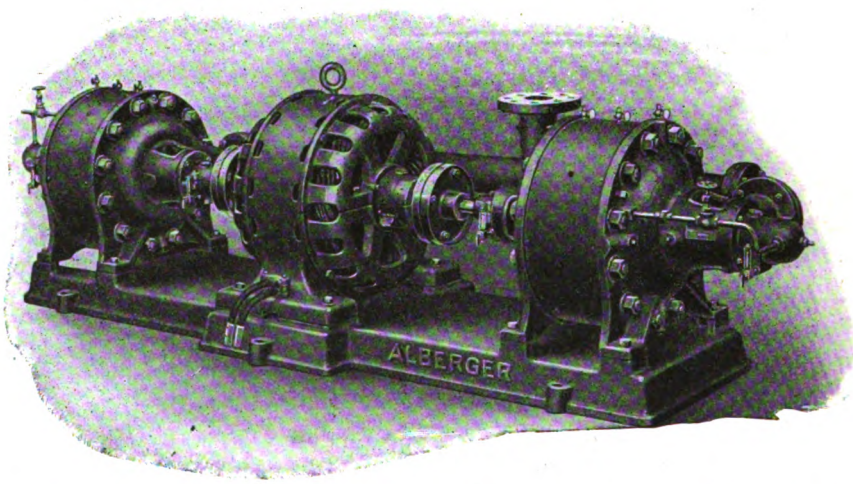


FIG. 4. TEN-STAGE TURBINE PUMPING UNIT, NORTH STAR MINES CO., GRASS VALLEY, CALIFORNIA. 400 G.P.M., 1400-FT. HEAD, 199 BRAKE HORSE-POWER.

should be water-sealed, a small pipe connection (9) being made to the discharge side of the pump for this purpose. A lantern gland or spacer should be used to prevent the packing from closing the water seal. There may then be a slight leakage of water through the packing which is unimportant, but the entry to the pump of air which is very detrimental to efficiency, is absolutely prevented. Split glands should not be used as they give rise to leakage.

Bearings.—The bearings (11 and 16) when necessary. The bearings should be of ample length, so as to minimize wear. A good rule of thumb is that the bearing should have a length equal to the diameter of the pump outlet, and this should correspond roughly to three shaft diameters.

Diffusion Vanes. — Diffusion rings (28) and vanes (27) used in turbine pumps should be carefully machined and finished, for the water velocities at the entrances are very high.

Casing. — The construction of the cast iron casing, especially the water

Generated on 2024-09-30 00:19 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

passages, should be given careful attention. Ordinary wet-sand molds used by the average foundry are not suitable for this work, as the surfaces of castings will be too rough. Only carefully prepared dry-sand molds can produce the smooth castings desirable for use in pumps. All sharp or exposed parts should be eliminated, being replaced where necessary by small parts constructed of non-corrosive composition. For convenience of manufacture, castings for the smaller sizes of pumps are usually cast in one piece with removable side plates or heads to give access to the inner parts. In large pumps and with ordinary heads the casing is often cast in two parts (Fig. 3 and 6), the division being along the horizontal centre-line of the shaft. The pipe connections and other parts are secured to the lower half, so that the upper half may be readily lifted and access to the pump gained without disturbing any other parts. This type of joint is more difficult to keep tight than the annular vertical joint, and requires careful machining and plenty of metal to give rigidity. Pumps for operating against high heads are invariably constructed with the division at right angles to the shaft centre-line (Fig. 1), and some engineers prefer this type for all services.

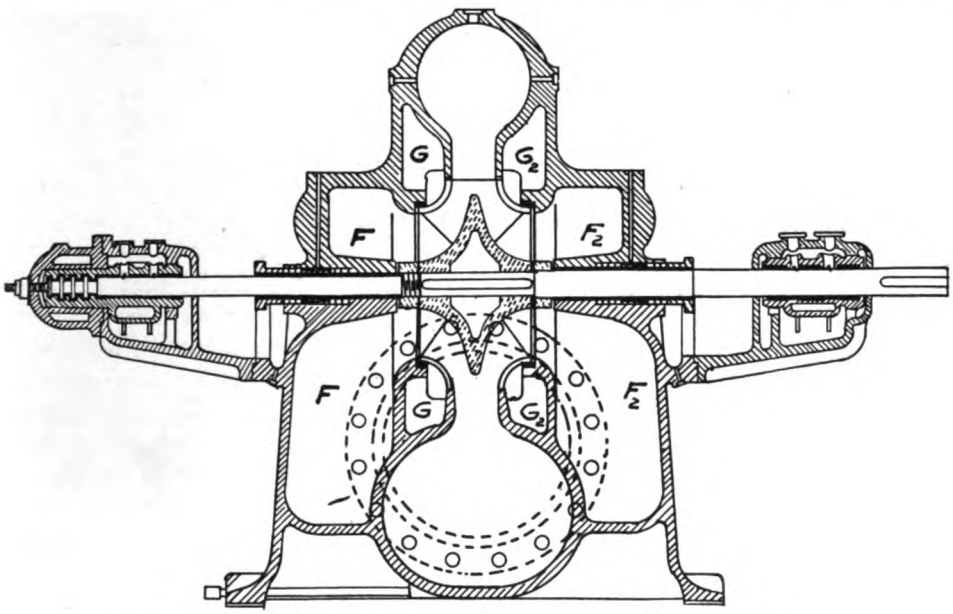


FIG. 6. HIGH-SPEED VOLUTE PUMP WITH HORIZONTAL SPLIT CASE.

Clearance Bushing Rings

One of the greatest sources of loss in a centrifugal pump is that due to short-circuiting of water from the impeller discharge to the impeller entrance, the water passing around the outside of the impeller, between it and the stationary pump casing. This loss is kept at a minimum by having very close clearances between the moving part (impeller) and stationary part (casing) at *B*. This clearance space will gradually enlarge from constant erosion of the water, and the capacity of the pump will decrease. Therefore, there should always be renewable bushing rings (4), which can be easily re-

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

placed, and the clearance maintained small. These should be of softer metal than the impeller, so that if rubbing should ever occur, the small rings would wear and not the impeller. The clearance surfaces should be wide, so as to present as much resistance as possible to the flow of water.

Hydraulic-Balance

On each side of the impeller of a centrifugal pump is water under pressure, tending to move the impeller and the shaft to which it is fastened in a direction along the centre line of the shaft.

Referring to Fig. 6, it will be observed that the area of the impeller exposed to the pressure of the water in chamber F is equal to the area exposed to that in F_2. Since the pressure of the water in these two passages is the same, and since the areas of application are the same, the total force exerted on the impeller by water in passage F is equal to that exerted by water in passage F_2. But these forces act in opposite directions, and neutralize each other, and therefore, as regards tense parts, the impeller is in balance. Likewise, areas G and G_2 are equal, and the pressures of the short-circuiting water are the same, and the impeller is theoretically in perfect balance.

In a single-suction pump, Fig. 2, it is necessary to have in the impeller a number of holes, H, so that the pressure of water in chamber F is the same as that in F_2, and of course the projected areas exposed to pressure must be the same. But it is practically impossible to construct any machine absolutely perfect, and, even if it were possible, it would not remain perfect, for wear will not be uniform. For this reason, more or less unbalanced thrust always exists, and if adequate mechanical provision is not made for taking care of this, trouble is sure to follow.

Thrust-Bearing

The best type of thrust-bearing (16) is that shown in Fig. 2, and consists of a number of shoulders on the shaft, bearing against babbit surfaces. This is known as the marine type because of its universal use on the propeller shafts of vessels, which is the most severe service. All centrifugal pumps should be provided with such a bearing, of liberal proportions. This bearing also serves the purpose of maintaining the moving passages, Id, in perfect alignment with the stationary passages E, which is essential to hydraulic efficiency.

Attempts have been made by some builders to balance the impellers by allowing the impeller and shaft to move parallel to the shaft, and by designing pressure-chambers such that a movement in one direction will increase the pressure in the opposite direction, and *vice versa*. Any such hydraulic floating balance requiring a lateral movement of the impeller discharge passes, Ie, is absolutely wrong for the alignment of the impeller discharge passages, and the volute or diffusion ring passages, E, are destroyed, eddy currents produced, and efficiency reduced. In the vertical pumps it is necessary also to provide for the support of the moving parts. Many builders attempt to accomplish this by exposing a greater area to the water-pressure on the bottom of the impeller than on the top, and to obtain a floating balance. This is wrong for the reason described above, and also because changes in the pumping head will destroy the theoretical balance. The only proper and satisfactory method of supporting the weight of the moving parts is with a liberal size thrust-bearing, preferably of the marine type.

Generated on 2024-09-30 00:23 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

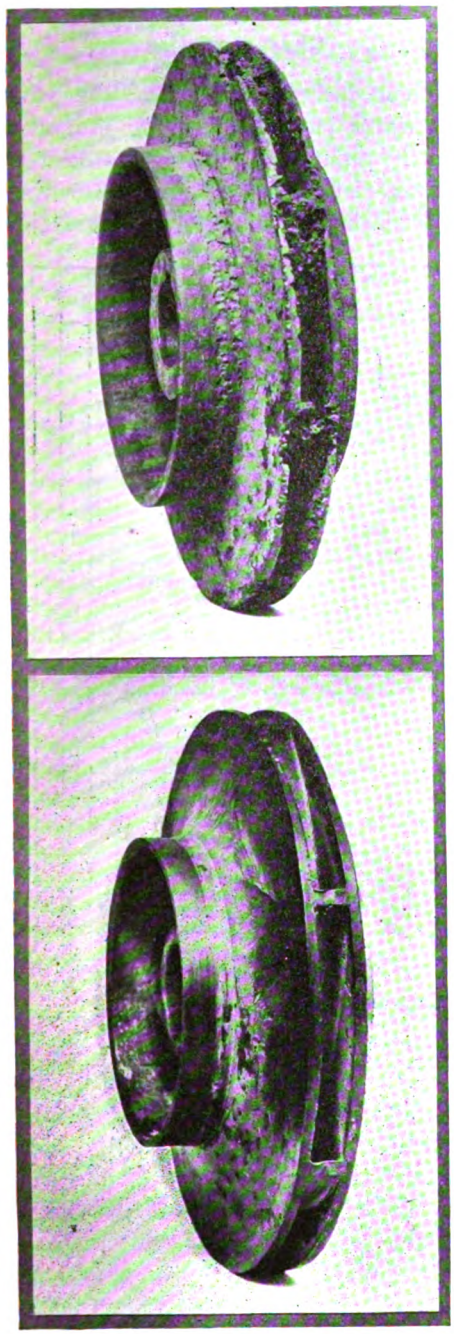


FIG. 8. IRON PUMP IMPELLER AFTER 11 MONTHS SERVICE.

FIG. 7. BRONZE PUMP IMPELLER AFTER 37 MONTHS SERVICE.

Single-Suction Pump Balance

There exists among many, a general idea that single-suction pumps cannot be satisfactorily balanced and that double-suction pumps are balanced and do not require thrust-bearings.

These ideas are erroneous. A single-suction impeller, if constructed as described above, is theoretically in balance, and is practically subject to unbalancing to no greater degree than double-suction impellers.

Materials

The materials of which a centrifugal pump is constructed are of the utmost importance. It is necessary, from consideration of cost, to construct the heaviest parts of cast iron. But this iron should be carefully prepared so as to be hard and close grained. The cheaper pumps are made with a very soft iron for the purpose of cheapening machine work. This makes a rough casting full of blowholes and which will wear and corrode rapidly.

Iron at best is a porous metal, cannot be given a high finish, and corrodes rapidly. For high efficiency it is essential to have the water passages, which are subjected to high velocity, very smooth. The passages of the impeller and diffusion vanes should be machined or chipped, and ground and polished to a high finish. Cast iron cannot be highly finished, and furthermore it will not retain its finish, but will almost immediately wear and corrode. On the other hand, special bronze compositions can be made that are very hard and will not wear, that are not subject to corrosion, and that can be given a high finish, and, even if wear does occur, the metal, being very close grained, maintains a smooth surface.

Fig. 7 and 8 show impellers taken from different pumps of similar size,

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

namely, 4-in., and of the same capacity, operating in the power-plant of the Southern Pacific Company, Fruitvale, under similar conditions and on the same fresh water. The impeller shown in Fig. 7, which is of bronze, has been in use 37 months and is still in service. It will be observed that there is no apparent wear, the surfaces all being smooth and bright. The impeller shown in Fig. 8, which is of cast iron, was removed after 11 months, owing to unfitness for further service. The entire impeller, it will be observed, is very rough, while the vanes are eaten away. When it is considered that the water passages are only about ½ in. wide, the enormous loss of power by surface friction can be appreciated.

Impellers, diffusion vanes, and shaft sleeves should invariably be of bronze, and the use of iron for these purposes should not be permitted.

Characteristics

When designed correctly, the vanes and water passages may be shaped so that the pump will, when operated, have characteristics previously determined as desirable. That is, the variations of efficiency and capacity with changes of head, may be accurately determined. As the relation of variables may be most easily shown by the use of curves, and few characteristics, pump curves will be of interest. Fig. 9 shows characteristics of the standard pump of a large American manufacturer when operated at constant speed. It will be observed that under no conditions of head, even with closed discharge valve, can a head more than

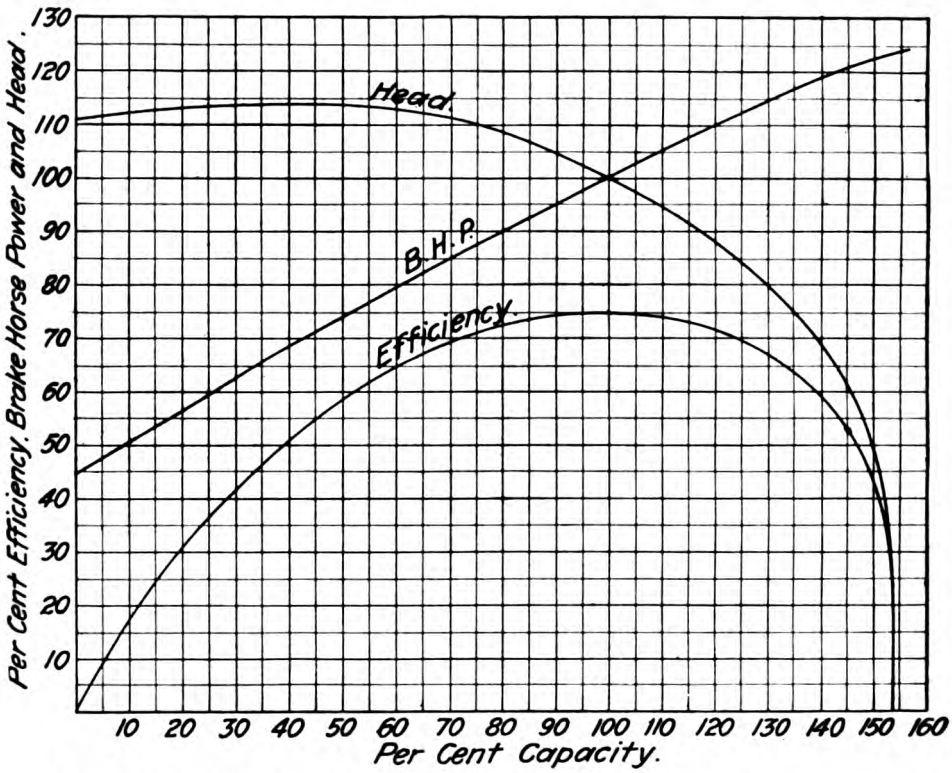


FIG. 9. CHARACTERISTIC CURVES FOR CENTRIFUGAL PUMPS, SUITABLE FOR FAIRLY CONSTANT HEAD.

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

14% above normal be obtained, so that dangerous stresses cannot come on pump casing or piping.

The power curve is very flat, so that under no condition of load can the horse-power required exceed the normal by more than 25%. This is important, especially with motor drive, for often the breaking of the discharge pipe, causing removal of head, results in the destruction of the motor. It will be further observed that slight variations of head above or below normal do not cause wide variations in capacity or efficiency. This is important, as it is often impossible to accurately determine the head when ordering a pump. The head is often variable, due to fluctuating water-level, and furthermore there is a tendency among purchasers to order a pump for a greater head than the head which they really expect to operate against. If it is known that the pump will be operated against a widely fluctuating head, such as when pumping from a river, or when pumping from wells, where the water-level varies considerably from season to season, it is often advisable to design for a much steeper head curve, or, in other words, so that large variation in head will produce comparatively small variation in capacity. Such a curve is shown in Fig. 10.

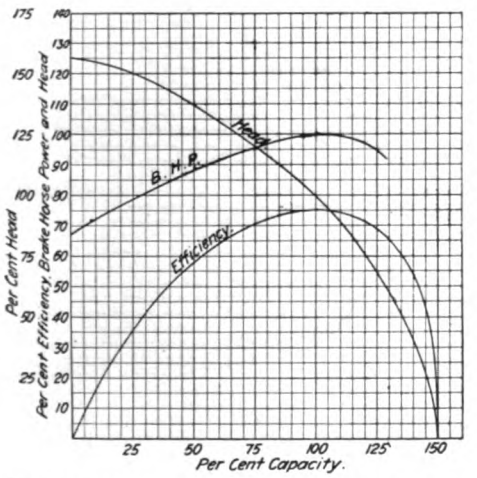


FIG. 10. CHARACTERISTIC CURVES OF CENTRIFUGAL PUMP, SUITABLE FOR WIDELY VARYING HEAD.

It will be seen from the above that efficiency for one given condition of operation is of only partial importance. The characteristics of the pump when operated under variable conditions are to be given equal consideration.

Methods of Drive

Electric motors, steam turbines, and steam or gas engines are the prime movers generally employed for driving centrifugal pumps. Electric motors, and steam turbines particularly, can be obtained which operate at speeds suitable for centrifugal pumps, so that the pump and motor may be direct-connected. Fig. 11 shows a steam-turbine-driven unit. In such a unit the power of the motor is transmitted direct to the pump without loss, the outfit is compact and well balanced, so that small foundations are sufficient, and there is no side pull on the shaft to cause wear on the bearings.

Gears, belts, chains, and other transmission devices greatly increase the mechanical difficulties, for in addition to the wear on these devices themselves, there is considerable wear on the bearings because of side pull on the shaft. The loss of power due to belt slippage, or chain or gear friction, will range from 5 to 10%, and in the small irrigation plant which does not receive careful attention will probably be usually near the higher figure. It is true that where the pumping head is exceedingly variable, slightly better pump efficiencies may be obtained by changing the pump speed, which with a belted unit can be accomplished by

Generated on 2024-09-30 00:25 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

changing the sizes of pulleys. But actually the operator will seldom take the trouble to do this, and even if this is done, there is the continual loss as described above, which will generally offset any saving from increased pump efficiency. The real reason that belted units are advocated by many builders is that, given a fixed speed, skill and care are required to design the pump for a desired head, while with belted units, if the pump will not operate satisfactorily at one speed, other speeds can be tried.

Many vertical pumps operating in the bottom of pits 30 to 150 ft. deep have the power transmitted by shafting, which may cause a power loss of 5 to 10%. If a belt is used to transmit the power from the motor to the shaft, the transmission losses may equal 10 to 20%, a very high figure. In addition to this loss, there must be considered the first cost and the expense and attention required by the transmission devices. The use of any but direct-connected units, especially with motor drive, should not be considered.

Methods of Installation

One of the foremost requisites of a good installation of any machine is accessibility for repairs. This at once eliminates the permanently-submerged pump. Serious stuffing-box or casing leaks may develop which cannot be detected and which may seriously affect the efficiency of the pump. The practical working limits for suction lift are from 20 to 25 ft., so that if the water-level is at a greater depth, an excavation must be made and the pump placed within that distance. The usual method employed is to dig a pit to surface

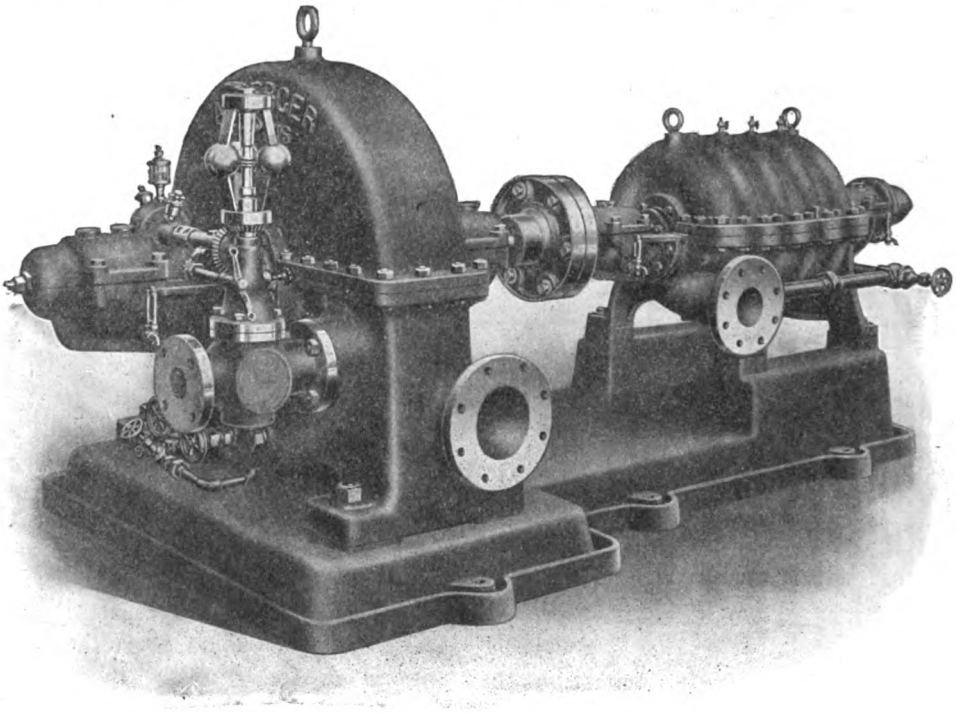


FIG. 11. FOUR-STAGE TURBINE PUMP, STEAM TURBINE DRIVEN. 6009 G.P.M., 580-FT. HEAD, 125 BRAKE HORSE-POWER.

Generated on 2024-09-30 00:22 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

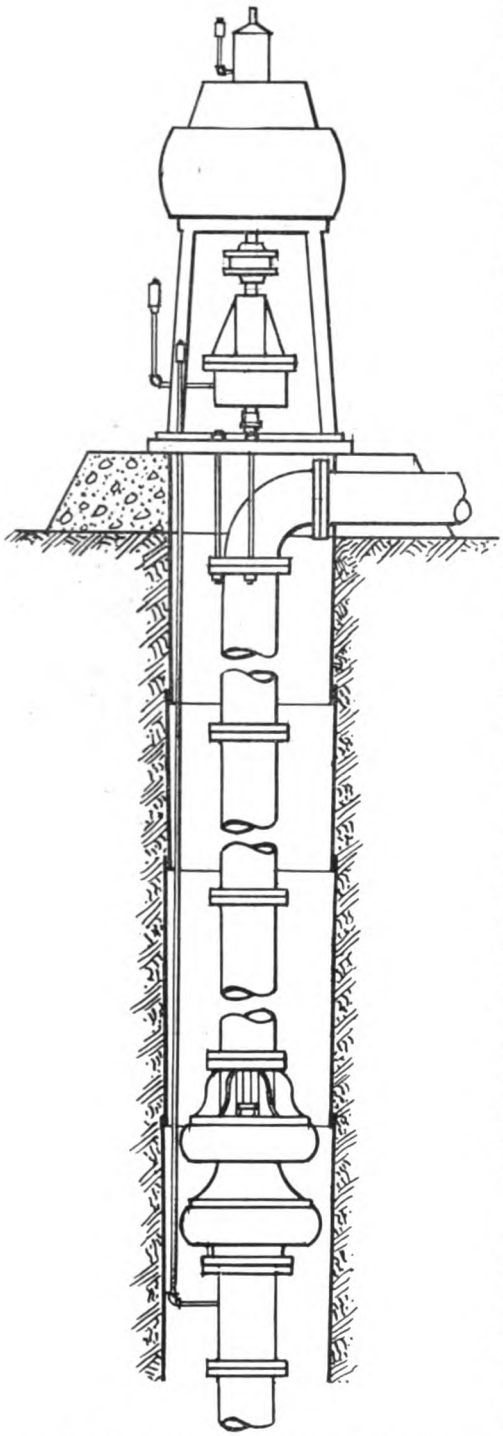


FIG. 12. WELL CASING TYPE DEEP-WELL CENTRIFUGAL PUMP.

water-level and case it with redwood. In the bottom of this is erected a vertical pump, the power being transmitted to it from the motor on the surface by vertical shafting and a pulley. Nearly every feature of this is objectionable. The shafting and belting absorb a large percentage of the power; the many shaft guide-bearings are difficult to keep in alignment, and require constant oiling and attention; the removal of the pump for inspection or repairs is exceedingly difficult; and the weight of the long shafting is difficult to balance.

To overcome these difficulties, the so-called well-casing type deep-well centrifugal pump has been developed by some builders. This consists of a vertical pump designed so that it may be lowered into a good-sized well-casing, and suspended by the operating shaft and piping (Fig. 12). This arrangement is even worse than the one previously described, for it has the additional disadvantage that the pump must be of cramped design, in which efficiency and wearing qualities must be sacrificed. It is absolutely inaccessible, and its removal by hoisting the piping, shafting, and pump is slow, difficult, and expensive, requiring a heavy derrick and rigging. The only advantage of this sort of an arrangement is that it causes the owner to bore a well of liberal diameter, and consequently secures a better water-supply than from a smaller well.

If the water-level is not far from the surface and is fairly constant, a pit of sufficient size should be dug to within a few feet of water-level and a horizontal direct-connected pumping unit installed. The pit need not be dug, for the modern alternating-current induction motor will not be affected by such moisture as would be present. If the water-level is 50 or 100 ft. from

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

the surface it is better to use a vertical unit, on account of smaller pit required and greater ease of removal. Fig. 13 shows the type of installation recommended by me for use where the water-level is constant or changes infrequently and slowly. A 4 by 6-ft. rectangular pit is sunk to water-level, and the pump and motor, as one substantial unit, are installed on the bottom. Thus all mechanical transmission devices are eliminated, and the full power developed by the motor is delivered to the pump. The starting and controlling apparatus are placed at the top, but a substantial ladder down the pit gives easy access for repairs if necessary. The removal of the pump or raising it to a higher level in case of higher water is easily accomplished by removing one section of discharge pipe. If the changes in water-level are frequent, then the motor must necessarily be placed a sufficient height above the pump to insure it against damage from submergence. Usually 20 ft. is sufficient, so that only one shaft guide-bearing will be required. Fig. 13 shows a typical installation. The pump should not be bolted down, that removal may be possible after submergence. The cost of a 4 by 6-ft. pit lined with a good quality redwood is about $4.50 per foot, or about the same as that of a 12-ft. diameter bored well. Concrete is not necessary; for the life of first-growth redwood or of white cedar is almost indefinitely long.

All piping should be standard weight, black, wrought, screw type, and should be thoroughly coated inside and out with good pipe-paint. Very little is saved by the use of thin riveted pipe, and its life is short. The discharge pipe should terminate at the lowest possible elevation. It is common practice among vendors of cheap pumps to have the discharge pipe terminate 3 or 4 ft. above the ditch, as the stream spreading as it falls gives a false appearance of quantity. Another trick is to point the discharge slightly upward instead of horizontal, so as to show a full pipe. Thus 3 or 4-ft. pumping head is added which may amount to 10 to 20% of the total, and the power bill enlarged accordingly.

First Cost

The initial cost of a really first-class plant is actually very little more than that of a cheap outfit. The pump is naturally more expensive, but owing to higher efficiency and high allowable speeds, the motor price will be less. The direct-connected unit eliminates the costs of belts, gear, shafting, etc., and greatly reduces the cost of foundations. And the buyer actually gets the capacity that he pays for.

The purchaser should demand that the pump be tested at the factory before shipment, and that copies of the test be furnished him, a request that will readily be complied with by the reputable manufacturers of high-grade pumps. A common apparatus used for this purpose is the weir, but I cannot recommend this because it necessarily adds say 2 ft. to the pumping head, and, unless carefully constructed, is not accurate. A better and cheaper instrument is the Pitot tube, a small, simple, compact, and accurate device which may be installed at some convenient point on the discharge pipe. It is argued by some that the farmer is more familiar with a weir and will place more confidence in its accuracy, but this is not to my mind sufficient reason for its use in preference to the much superior Pitot tube.

Cost of Water

If a plant be carefully constructed along the lines described above, an over-all efficiency of 60 to 65% can be

Generated on 2024-09-30 00:19 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

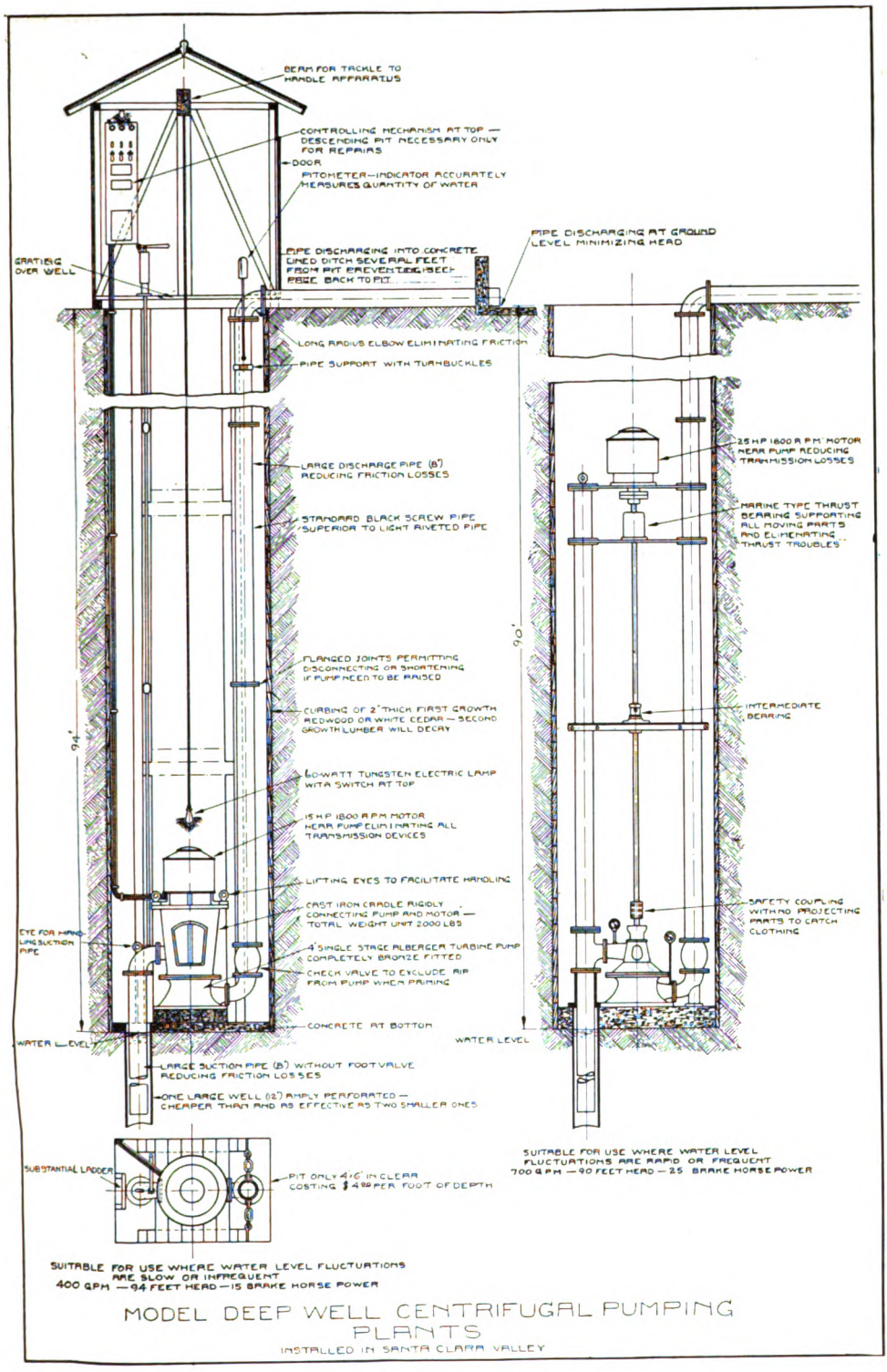
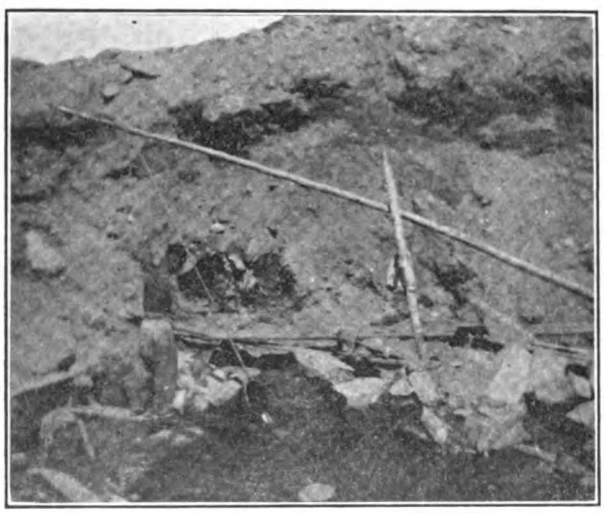


FIG. 13. MODEL DEEP-WELL PUMPING PLANTS.

Generated on 2024-09-30 00:25 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

obtained. Electric current for power is usually available at 2c. per kilowatt-hour or cheaper. Assuming a lift of 40 ft., this means a cost for water of 42c. per 1000 gal., or $1.37 per acre-foot. Four and one-half acre-foot irrigations per year, or a total of two acre-feet (24 in.) in general is ample for most any crop. This would give a total cost per acre per year for water of $2.74. This compares very favorably with gravity-system costs, which range from $2 to $9 per acre per year. Pumping has always the great advantage of being available when wanted, which is not true of most gravity systems. These figures are necessarily a mere example. Often the power costs are less than 2c., the pumping head less than 40 ft., and the quantity of water required per year less than 2 ft., so that in many cases the cost of water is much less.

Irrigation by water pumped from wells has many advantages over the use of gravity water, such as elimination of wild-seed distribution, independence of stream flow, reduction of seepage losses, insurance against crop losses, etc., the discussion of which is beyond the scope of this article.



BUCKET AND SWEEP EMPLOYED IN SIBERIA BY NATIVES FOR PUMPING WATER.

Generated on 2024-09-30 00:22 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

The Engineering Digest

Three-Two Method of Rope Splicing*

By ALEX WILSON

ROPE splicing is at times an important and urgent matter. To become proficient in this line of work requires practice; therefore, it is not proposed to make every reader of this article a rope splicer, but it is hoped that every reader will be able to understand from the sketches and explanations how a rope can be spliced. Of the several methods of doing this work the 'overlap' or 'rapid' method of splicing as it is called, belies its name. The 'one-in-one' method is probably the best for joining a new rope, and 'three-two' method is probably the best for ropes that have been in use. All three methods give the same results so far as appearance goes, that is, when the ropes are joined there will be six crossings and twelve ends in view, but there is a difference in the butting-in each instance: In the 'one-in-one' method there is a place known as the common centre; that is to say, in a 30-ft. splice the ropes are unwound 15 ft. on each end, and when both ends are brought together the place where they meet is termed the common centre or butt. As the 'overlap' method and the 'one-in-one' method are known to many, particular attention is given to the 'three-two' method.

I use this method on ropes that have been in use. The tools needed by the rope splicer for this work are a round marlin spike, sometimes termed a 'needle,' a round marlin spoon, a cold cut or hardy, a hand hammer, a sledge, a pocket knife, a piece of strong cord, a roll of friction tape, and sometimes a screw clip.

The first operation is to unlay one end of the rope that is to be spliced, for about 30 ft., then unlay the other end for 1½ ft., then cut out the core of hemp. After this operation the rope will look as in Fig. 1. Next take the rope with the short ends and place each end alongside of the long ends of the other rope, crossing them over each other; then pull the two ropes close together, see that the hemp cores exactly meet, and fasten one of the short ends to the rope to which the long ends belong; this prevents any misplacing of the strands.

It will now be observed that the long ends

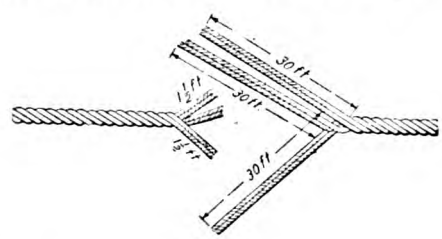


FIG. 1

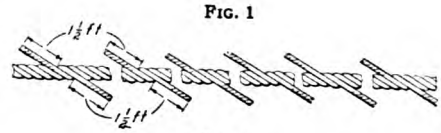


FIG. 2

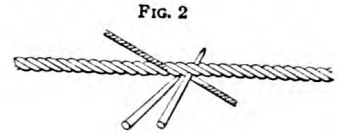


FIG. 3

are entirely free, and if they are in their proper position the interweaving of the strands may now be commenced. One of the double short strands is run off the rope while one of the double long strands is run in to the place from which the short strand came out. When about 7 ft. 4 in. from the end of the double strand the operator stops and singles out the strands leaving two of the single ones at this point to form a crossing, the other two single strands are then

*Abstract from *The Colliery Engineer*, July 1913.

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

worked 5 ft. 8 in. farther on, so that they form a crossing also; there is now 1½ ft. of the long strand still in view so that the other strand, which forms the crossing, is also cut off, leaving 1½ ft. for hiding. The second and third double strands follow in the same way leaving 5 ft. 8 in. between the crossings, as shown in Fig. 2. It will now be observed that there is one crossing left exactly where the two ropes butted together, thus saving the trouble of running-in two strands so that the short end to begin with is 1½ ft.; therefore, there is no cutting to do on that strand. The splice should now have six crossings and twelve ends in view, as shown in Fig. 2. To hide the ends is the next operation, and this means taking out the centre core so that the ends can be put into place that the rope may have a uniform appearance. The ends are all covered with a piece of friction tape and the marlin spike driven through the centre of the rope where the two strands cross each other. The rope is then pried open so that the core can be cut and taken out sufficiently far to allow the strand to bed itself in the rope. The spike is then brought back to the crossing again and driven through the centre of the rope. The spoon is then placed alongside of the spike, the strand placed between the tools and held down by a helper in the direction it is to take in the rope. Now pull the spoon toward the body, and at the same time push the spike away from the body. The result of this operation will allow the strand to go into the rope where the core came out. The spike is then taken out, the spoon only being needed to keep the strand in place. The spoon is whirled round with the twist of the rope until the whole of the strand is bedded from view. The spoon is then taken out and the operation proceeds in the same way with all the rest of the ends. The position of the tools when hiding an end in a rope is shown in Fig 3.

There is no need for tying the ends of the rope where the crossings are made, as shown in some sketches. All that is required is to have the strands crossed in such a way that they will lock with each other. I have seen 32 ropes put together in one afternoon in a rope-splicing contest and none of the teams in the competition used a string or cord where crossings were made on the rope.

Seattle Light and Power Plants*

SEATTLE has available at the present time for light and power purposes 86,475 kw., or 116,000 hp. of electrical energy, generated either by steam or water power, as shown in detail below. As the privately and municipally owned plants all have bus-bar intercommunication, there is guaranteed a continuity of service which is essential to manufacturers. To still further insure reliability of service, both the privately and municipally owned plants are installing extra storage-battery capacity. The present rates for electrical power are very favorable to low manufacturing costs, and the future undoubtedly will bring forth still lower rates, as many new water-power propositions are either being projected, developed, or enlarged in capacity.

Plants supplying electrical energy for light and power purposes must make provision to take care of peak loads on some days in the winter season which tax the plant to its very ultimate capacity for a few hours and leave idle 97% of the time a large amount of its capacity. There are load curves wherein the load on a winter day varies from 5500 kw. to 36,400 kw. The peak load on a summer day does not reach within 9200 kw. of that carried on a winter day, and the range of load fluctation is not so pronounced. Tremendous amounts of water power available for the generation of electrical energy are not utilized, and it is to be hoped that some process will be developed, such as that of generating nitrogen out of the air by electricity or of wood products distillation by electrical heaters, which will enable Seattle to secure the benefits of what is at present an economic waste. Could this available power which at present

*Abstract from annual report by A. L. Valentine, Superintendent Public Utilities Department, Seattle, Washington.

Generated on 2024-09-30 00:25 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

is waste, be utilized, rates for electricity for light and power purposes could be substantially reduced, which would offer an added inducement to industrial enterprises.

POWER AND LIGHTING, CAPACITY AND LINES

	Puget Sound Traction, Light & Power Co...	City.	Total.
Kw. cap. water	53,750	15,325	69,075
Kw. cap. steam	17,400	.....	17,400
Cap. main sub-station	46,330	12,000	58,330
Cap. aux. sub-stations	43,409	2,400	45,809
Number sub-stations	12	3	15
Max. street ry. load	20,288	.....	20,288
Max. light and power load	16,112	8,700	24,812
Mileage high-tension	57.2	80	137.2
Mileage 15,000 to 7500 volts	....	32.6	32.6
Mileage trolley	192.7	.....	192.7
Mileage street lighting wire	....	743	743
Mileage commercial lighting wire	720	1850.1	2570.1
Number street arcs	71	925	996
Number street incandescents	....	5,816	5,816
Miles of street lighted	10.5	725	735.5
Number cluster light poles	....	1,671	1,671

Energy Density*

By CHARLES P. STEINMETZ

WHILE electric energy is the most convenient form to transmit and distribute, there exists no economical method of storing electric energy; the electric storage battery does not store electric energy, but stores chemical energy, by double conversion from electrical to chemical, during charge, and from chemical to electrical, during discharge. It is thereby limited in economical usefulness. As the result, electrical energy essentially plays the part of the connecting link joining the source of energy—nature's fuel supply or water-power—with the energy consumer.

As energy storage is essential throughout all modern industrial life, the maximum weight and space efficiency which may be reached with the different methods of energy stored chemical energy.

CHEMICAL ENERGY

1 kg. of hydrogen contains 33 kw-hr. stored chemical energy, which is set free as heat in combustion.

1 kg. of gasoline contains about 13 kw-hr. and 1 litre of gasoline about 10 kw-hr. of stored chemical energy.

1 kg. of the lightest storage battery contains less than 120 watt-hours of stored energy.

MECHANICAL ENERGY

The highest mechanical energy density obviously is found in the rifle bullet or cannon ball; and, at the highest bullet velocities of about 1000 metre-seconds, represents 0.14 kw-hr. per kg. Thus a tungsten bullet (sp. g. 20) carries nearly 3 kw-hr. per cubic decimetre (litre) of volume, that is, approaches the energy density of chemical storage. Thus the impact of a tungsten bullet approaches the destructiveness of the detonation of the same volume of high explosive. This explains the interest taken in the introduction of tungsten as bullet material.

The highest velocities in rotating machinery are reached in the revolving rim of the steam turbine disk, approaching 200 metre-seconds, and representing a stored energy of 5.6 watt-hours per kilogram of rim weight.

HYDRAULIC ENERGY

At the highest heads of water-powers, of about 1000 metres, the energy density would be only 2.8 watt-hours per kilogram or litre

*Abstract from *General Electric Review*, July 1913.

Generated on 2024-09-30 00:24 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

of water, and thus would be less than a thousandth of the energy density of chemical storage. However, the ease and simplicity of storing large quantities of water in reservoirs make hydraulic storage of economical importance.

Electrical Energy

Dielectric: At the limits of disruptive strength of the most resisting material, mica, of one million volts per centimetre, the energy stored in the electrostatic field is only 0.05 watt-hour per cubic decimetre or litre, that is, it is insignificant compared even with mechanical storage.

Magnetic: At the highest magnetic densities ever reached in iron (of B = 60,000 lines of magnetic force per cm^2, at H = 40,000) the energy density is 28 watt-hours per cubic decimetre or litre—of about the same magnitude as in the average storage battery.

In power limiting reactances, under short-circuit conditions, in the air-field inside the reactance, energy densities as high as 2 watt-hours per litre are reached.

Progress of the California State Highway*

As shown by the table below, routes 9*a*, 10, 11 and 12, aggregating 214 miles, have been added to the State Highway System since last October. This increased mileage on account of these routes, however, has been nearly offset by the reduced length of portions of the old routes as determined by the surveys, as follows:

Route 1, reduced 11 miles; route 2, 57 miles; route 3, 34 miles; route 4, 55 miles; route 5, 8 miles; route 7, 36 miles—a total reduced mileage of old route of 201 miles.

These twelve routes are described as follows:

Route.		Miles.
1.	San Francisco to Oregon line	410
2.	San Francisco to San Diego via Los Angeles	535
3.	Sacramento to Oregon via east side Redding	310
4.	Sacramento to Los Angeles via San Joaquin valley	390
5.	Stockton to Santa Cruz via Oakland	125
6.	Sacramento to Woodland Junction	20
7.	Tehama to Benicia	155
8.	Hopland to Vallejo via Lake county	107
9. 9*a*.	San Fernando to San Bernardino and Riverside	105
10.	Hanford to Visalia	20
11.	Folsom to Placerville	30
12.	San Diego to El Centro	105
	Total	2312

To date, the number of layouts is 38, aggregating a total length of 280 miles. The number of road contracts to date is 29, and their aggregate length is 206 miles, and their total cost will be $1,753,748.

Route 1.

Marin. Secs. A and B. Surveys complete. Plans in progress.

Sonoma. Sec. B. Laid out as a State Highway September 25, 1912. Contract awarded October 22, 1912 to Richard Keating & Sons. Length, 13.7 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, $109,050. Probable cost per mile, $7,960. Per cent of contract complete March 15, 1913, 4.2 per cent. Secs. A and C. surveys complete and plans in progress.

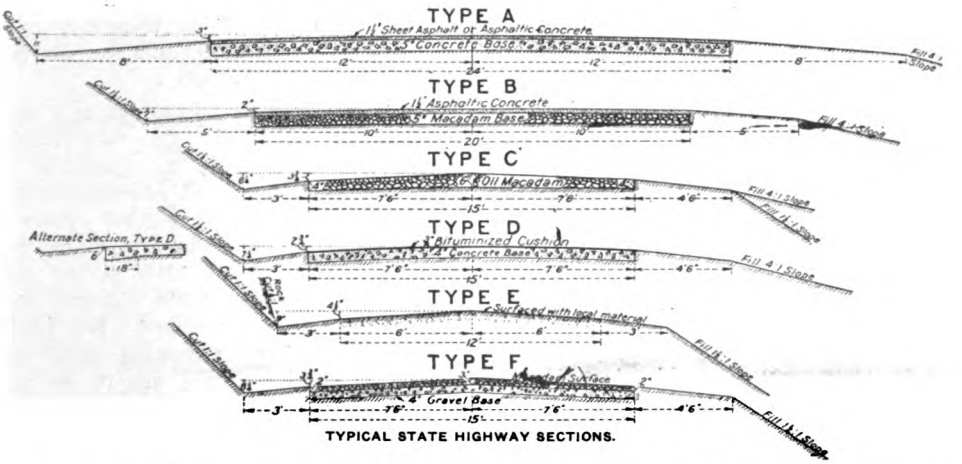
Mendocino. Sec. A. Laid out as a State Highway May 21, 1912. Contract awarded July 23, 1912, to the General Constructing Corporation. Length, 12.8 miles. Road to be graded 18 feet wide but not paved. Probable total cost, $69,900. Probable cost per mile, $5,460. Per cent of contract complete March 15, 1913, 90 per cent. Sec. C. Laid out as a State Highway February 4, 1913. Contract awarded March 26, 1913, to D. L. Sawyers and C. Whited. Length, 7.6 miles. Road to be water bound macadam and gravel 15 feet wide. Probable total cost, $55,665. Probable cost per mile, $7,325. Sec. E. Laid out as a State Highway October 22, 1912. Contract awarded February 4, 1913, to Fairbanks & Baechtel. Length, 6.9 miles. Road to be graded 18 feet wide. Probable total

*Abstract from *California Highway Bulletin*, May 1913.

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Table of Layouts, Showing Mileages, Types of Roads, Probable Costs, and Names of Contractors

Layout.	Contract.	Division.	County.	Route.	Section.	Miles.	Total probable cost exclusive of engineering and overhead	Type of pavement.	Contractor Corrected to May 1, 1912
1	1	IV	San Mateo	2	A1	5.4	$92,177	24 feet sheet asphalt on Portland cement, concrete base.	F. R. Ritchie.
2	2	I	Mendocino	1	A	13.2	69,886	18 feet graded	General Contracting Corp.
3	3	VI	Madera	4	B	9.9	74,254	15 feet oil macadam	Ransome-Crummey Co.
4	4	III	Yuba	3	B	8.9	69,928	15 feet oil macadam	F. E. Frey.
5	5	III	Stanislaus	4	A	11.1	77,892	15 feet oiled concrete	E. O. Burge.
6	6	VI	Merced	4	D	9.6	74,777	15 feet oiled concrete	Worswick Street Paving Co.
7	7	VII	San Diego	2	A	8.4	68,091	15 feet oiled concrete	M. L. Curtis & Co.
8	14	IV	Santa Clara	2	A1	6.4	43,274	20 feet asphaltic concrete on macadam base.	City Street Improvement Co.
.....	15	IV	Santa Clara	2	A2	5.5	47,338	20 feet oiled concrete	A. Teichert & Son
9	8	VI	Fresno	4	C	9.6	62,616	15 feet oiled concrete	Worswick Street Paving Co.
10	9	VI	Madera	4	A	9.9	66,512	15 feet oiled concrete	Worswick Street Paving Co.
11	10	VI	Madera	4	C	6.8	46,100	15 feet oiled concrete	Worswick Street Paving Co.
12	11	VI	Merced	4	C	10.9	84,711	15 feet oiled concrete	Worswick Street Paving Co.
13	.....	VII	Ventura	2	F	4.4	.....		
14	12	III	Sacramento	3	A	1.8	13,277	15 feet oiled concrete	Burns, Clark & DaRoza.
15	13	III	Placerville	3	A	9.9	83,600	15 feet oiled concrete	Burns, Clark & DaRoza.
16	16	III	Sonoma	1	B	13.7	108,761	15 feet oiled concrete	Rich. Keatinge & Sons.
17	17	VII	Los Angeles	2	A	6.6	49,928	15 feet oiled concrete	Rogers Bros. Co.
18	.....	VI	Merced	4	A	14.2	.....	15 feet oiled concrete	E. O. Burge.
19	5 Ex.	III	Stanislaus	4	A	0.7	4,907	15 feet oiled concrete.	
20	.....	III	Butte	3	D	11.2	.....	15 feet oiled concrete.	
21	29	IV	San Mateo	2	A2	0.2	4,825	24 feet asphaltic concrete on Portland cement, concrete base.	Clark and Henery Const. Co.
22	22	IV	San Mateo	2	B1	3.3	42,980	20 feet asphaltic concrete on macadam base.	S. P. Doyle.
23	23	IV	Santa Clara	2	B1	13.0	87,863	15 feet oiled concrete	Rich. Keatinge & Sons.
24	.....	V	San Luis Obispo	2	D	6.4	.....	15 feet oiled concrete.	
25	.....	V	Monterey	2	E	7.3	.....	15 feet oiled concrete.	
26	.....	VII	San Diego	2	B	10.4	.....	15 feet oiled concrete.	
27	20	I	Mendocino	1	E	6.9	52,911	18 feet graded	Fairbanks & Baechtel.
28	24	I	Mendocino	1	C	7.6	55,651	15 ft. water-bound macadam, gravel	D. L. Sawyers and C. Whited.
29	21	VII	Los Angeles	2	B	10.1	81,690	15 feet oiled concrete	John D. Marsh.
30	25	III	Stanislaus	4	B	9.6	68,154	15 feet oiled concrete	Considine & Bates.
31	5 Ex.	III	Stanislaus	4	A	0.3	2,049	15 feet oiled concrete	E. O. Burge.
32	4 Ex.	III	Yuba	3	B	0.3	5,302	15 feet oiled macadam	F. E. Frey.
33	26	IV	San Mateo	2	A3	1.0	20,415	24 feet asphaltic concrete on Portland cement concrete base.	Flinn and Treacy.
34	27	IV	San Mateo	2	B2	1.8	20,215	20 feet asphaltic concrete on macadam base.	Raisch Improvement Co.
35	28	IV	Santa Clara	2	B2	4.3	34,235	15 feet / 20 feet oiled concrete	Richard Keatinge & Sons.
36	.....	VII	Ventura	2	A	7.3	.....	15 feet oiled concrete.	
37	.....	IV	Santa Clara	2	A3	1.2	.....	20 feet oiled concrete.	
38	.....	VII	Los Angeles	2	C	11.3	.....	15 feet oiled concrete.	



TYPICAL STATE HIGHWAY SECTIONS.

cost, $32,845. Probable cost per mile, $4,760. Secs. B, D and F. Surveys and plans complete. Secs. I and J. Surveys complete and plans in progress. Secs. G, H and K. Surveys nearly complete.

HUMBOLDT. Sec. A. Survey complete and plans in progress. Secs. B, C, D, E, F, and G. Surveys begun.

ROUTE 2.

SAN MATEO. Sec. A. Survey complete. A1. Laid out as a State Highway May 21, 1912. Contract awarded July 23, 1912, to F. R. Ritchie & Co. Length 5.4 miles. Sheet asphalt 24 feet wide on concrete base. Probable cost, $92,180. Probable cost per mile, $17,070. Per cent of contract completed to March 15, 1913, 66 per cent. A2. Laid out as a State Highway October 22, 1912. Now advertised for contract. Length, 0.2 mile. Road to be of asphaltic concrete on portland cement concrete base 24 feet wide. A3. Laid

Generated on 2024-09-30 00:20 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

out as a State Highway March 26, 1913. Now advertised for contract. Length, 1.0 mile. Road to be of asphaltic concrete on portland cement concrete base 24 feet wide. Sec. B. Surveys and plans complete. B1. Laid out as a State Highway October 22, 1912. Contract awarded March 26, 1913, to S. P. Doyle. Length, 3.3 miles. Road to be asphaltic concrete on macadam base 20 feet wide. Total probable cost, $42,980. Total cost per mile, $13,025. B2. Laid out as a State Highway March 26, 1913. Now advertised for contract. Length, 1.8 miles. Road to be asphaltic concrete on macadam base 20 feet wide.

SANTA CLARA. Secs. A and B. Survey and plans complete. A1. Laid out as a State Highway July 23, 1912. Contract awarded October 22, 1912, to City Improvement Company. Length, 6.4 miles. Road to be asphaltic concrete on macadam 20 feet wide. Probable total cost, $43,275. Probable cost per mile, $6,760. A2. Laid out as a State Highway July 23, 1912. Contract awarded October 22, 1912, to A. Teichert & Son. Length 5.5 miles. Pavement, oiled concrete 20 feet wide. Probable total cost, $47,315. Probable cost per mile, $8,600. Per cent of contract completed to March 15, 1913, 57.7 per cent. B1. Laid out as a State Highway October 22, 1912. Contract awarded March 26, 1913, to Richard Keatinge & Sons. Length, 13.0 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, $87,865. Probable cost per mile, $6,760. B2. Laid out as a State Highway March 26, 1912. Now advertised for contract. Length, 4.3 miles. Pavement, oiled concrete 15 and 20 feet wide. Sec. C. Survey complete and plans in progress.

SAN BENITO. Survey complete.

MONTEREY. Secs. B and H. Surveys and plans complete. Sec. E. Laid out as a State Highway October 22, 1912. Length, 7.3 miles. Pavement, oiled concrete 15 feet wide. Secs. C, D, F, G, and I. Surveys complete. Sec. A. Survey nearly complete.

SAN LUIS OBISPO. Secs. A, C, and D. Surveys and plans complete. D1. Laid out as a State Highway October 22, 1912. Bids received and rejected November 18, 1912. Length, 6.4 miles. Pavement, oiled concrete 15 feet wide. Secs. B and E. Survey complete and plans in progress. Sec. F. Survey complete.

SANTA BARBARA. Secs. B and G. Surveys and plans complete. Secs. A and F. Surveys complete and plans in progress. Secs. C, D, and E. Surveys complete. Sec. H. Survey started.

VENTURA. Sec. A. Laid out as a State Highway March 26, 1913. Now advertised for contract. Length, 7.3 miles. Pavement, oiled concrete 15 feet wide. Sec. F. Laid out as a State Highway August 27, 1912. Length, 4.4 miles. This section includes a long timber trestle which was taken over by the state. Secs. B, C, D, E, and G. Surveys complete and plans in progress. Secs. H and I (alternate route). Surveys complete.

LOS ANGELES. Sec. A. Laid out as a State Highway September 25, 1912. Contract awarded October 22, 1912, to Rogers Bros. Co. Length, 6.6 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, $50,090. Probable cost per mile, $7,590. Per cent of contract completed to March 15, 1913, 45.8 per cent. Sec. B. Laid out as a State Highway February 4, 1913. Contract awarded March 4, 1913, to John D. Marsh. Length, 10.1 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, $81,755. Probable cost per mile, $8,095. Sec. C. Survey and plans complete.

ORANGE. Secs. A, B, C, E, and F. Surveys complete and plans in progress. Sec. D. Survey complete.

SAN DEIGO. Sec. A. Laid out as a State Highway July 23, 1912. Contract awarded August 27, 1912, to M. L. Curtis & Co. Length, 8.4 miles. Oiled concrete 15 feet wide. Probable total cost, $68,090. Probable cost per mile, $8,105. Per cent of contract completed to March 15, 1913, 54 per cent. Sec. B. Laid out as a State Highway October 22, 1912. Bids received. No award. Length, 10.3 miles. Pavement, oiled concrete 15 feet wide. Secs. C and D. Surveys and plans complete.

ROUTE 3.

SACRAMENTO. Sec. A. Laid out as a State Highway August 27, 1912. Contract awarded September 25, 1912, to Burns, Clark & Da Rosa. Length, 1.8 miles. Oiled concrete 15 feet wide. Probable total cost, $13,320. Probable cost per mile, $7,400. Per cent of contract completed March 15, 1913, 93.8 per cent.

PLACER. Sec. A. Laid out as a State Highway August 27, 1912. Contract awarded September 25, 1912, to Burns, Clark & Da

Generated on 2024-09-30 00:20 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Rosa. Length, 9.9 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, $83,820. Probable cost per mile, $8,465. Per cent of contract completed March 15, 1913, 25.0 per cent. Sec. B. Surveys complete and plans in progress.

YUBA. Sec. B. Laid out as a State Highway May 21, 1912. Contract awarded July 23, 1912, to F. E. Frey. Length, 9.2 miles. Oiled macadam 15 feet wide. Probable total cost, $75,230. Probable cost per mile, $8,175. Per cent of contract completed March 15, 1913, 66.4 per cent. Sec. A. Survey complete and plans in progress.

SUTTER. Surveys and plans complete.

BUTTE. Sec. D. Laid out as a State Highway October 22, 1912. Bids received November 18, 1912 and rejected. Length, 11.2 miles. Pavement oiled concrete 15 feet wide. Secs. A, B, C. Surveys complete.

TEHAMA. Secs. A and C. Surveys and plans complete. Sec. B. Survey nearly complete.

SHASTA. Secs. B and C. Survey complete and plans in progress. Sec. A. Survey complete. Sec. C. Survey begun.

SISKIYOU. Sec. A. Survey complete and plans in progress. Secs. B and C. Surveys begun.

ROUTE 4

SACRAMENTO. Built by the county.

SAN JOAQUIN. Built by the county.

STANISLAUS. Sec. A. Laid out as a State Highway July 23, 1912. Contract awarded August 27, 1912, to E. O. Burge. Length, 12.1 miles. Oiled concrete 15 feet wide. Probable total cost, $84,850. Probable cost per mile, $7,010. Per cent of contract completed March 15, 1913, 55.9 per cent. Sec. B. Laid out as a State Highway March 4, 1913. Contract awarded March 26, 1913, to Considine & Bates. Length, 9.6 miles. Pavement, oiled concrete 15 feet wide. Probable total cost, $68,155. Probable cost per mile, $7,100.

MERCED. Sec. A. Laid out as a State Highway October 22, 1912. Bids received. No award. Length, 14.2 miles. Pavement, oiled concrete 15 feet wide. Sec. C. Laid out as a State Highway August 27, 1912. Contract awarded September 29, 1912, to the Worswick Street Paving Company. Length, 10.9 miles. Oiled concrete 15 feet wide. Probable total cost, $84,805. Probable cost per mile, $7,780. Per cent of contract completed to March 15, 1913, 15.9 per cent. Sec. D. Laid out as a State Highway July 23, 1912. Contract awarded August 27, 1912, to the Worswick Street Paving Company. Length, 9.6 miles. Oiled concrete 15 feet wide. Probable total cost, $74,775. Probable cost per mile, $7,790.

MADERA. Entire county under contract. Sec. A. Laid out as a State Highway July 23, 1912. Contract awarded August 27, 1912, to the Worswick Street Paving Company. Length, 9.9 miles. Oiled concrete 15 feet wide. Probable total cost, $66,510. Probable cost per mile, $6,720. Sec. B. Laid out as a State Highway May 21, 1912. Contract awarded July 23, 1912, to Ransome Crummey Company. Length, 9.9 miles. Oiled macadam 15 feet wide. Probable total cost, $74,-255. Probable cost per mile, $7,500. Per cent of contract complete April 1, 1913, 53.3 per cent. Sec. C. Laid out as a State Highway July 23, 1912. Contract awarded August 27, 1912, to Worswick Street Paving Company. Length, 6.8 miles. Oiled concrete 15 feet wide. Probable total cost, $46,100. Probable cost per mile, $6,780.

FRESNO. Sec. C. Laid out as a State Highway July 23, 1912. Contract awarded August 27, 1912, to the Worswick Street Paving Company. Length, 9.6 miles. Oiled concrete 15 feet wide. Probable total cost, $62,615. Probable cost per mile, $6,520. Per cent of contract completed to March 15, 1913, 73.4 per cent. Secs. A and B. Surveys and plans complete.

TULARE. Secs. A, B, C, and E. Surveys complete and plans in progress.

KERN. Secs. C, D, E, and F. Surveys and plans complete. Secs. A and B. Surveys complete and plans in progress.

LOS ANGELES. Secs. A, B, C, and D. Surveys complete and plans in progress.

ROUTE 5.

SAN JOAQUIN. Built by the county.

ALAMEDA. Secs. A, B, C, and D. Surveys complete.

SANTA CLARA. Sec. A. Survey complete. Sec. B. Survey complete.

SANTA CRUZ. Sec. A. Survey complete and plans in progress.

ROUTE 6.

YOLO. Sec. A. Survey nearly complete and plans in progress.

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

ROUTE 7.

SOLANO. Secs. C and D. Surveys complete. Sec. E. Survey in progress. Secs. A and B. Surveys not begun.

YOLO. Sec. B. Survey complete and plans in progress. Secs. A and C. Surveys complete.

COLUSA. Secs. A, B, and C. Surveys complete.

GLENN. Secs. A, B, and C. Surveys complete.

TEHAMA. Sec. A. Survey complete.

ROUTE 8.

Surveys not begun.

ROUTE 9.

LOS ANGELES. Sec. A. Survey complete. Sec. B. Survey in progress.

SAN BERNARDINO. Secs. A, B, C, and D. Surveys complete.

ROUTE 9A.

SAN BERNARDINO. Secs. A and B. Surveys complete and plans in progress.

RIVERSIDE. Sec. A. Survey complete and plans in progress.

ROUTE 10.

TULARE. Sec. A. Survey and plans complete.

KINGS. Sec. A. Survey and plans complete.

ROUTE 11.

SACRAMENTO. Sec. A. Survey complete and plans in progress.

EL DORADO. Secs. A and B. Surveys nearly complete.

ROUTE 12.

SAN DIEGO. Secs. A and B. Surveys complete. Secs. C, D, E, F, and G. Surveys in progress.

Transformer Capacity and Connections for Induction-Motor Feeder-Circuits*

By J. L. MOON

THE question as to the nature of the load—inductive or non-inductive, which is to be placed on the various feeders of a supply system determines to a large extent the regulating capabilities which must be provided in the design of the generator and switchboard equipment. The same matter also comes up in selecting the sub-station equipment, and affects the transformer capacity and connections. Thus, while with a non-inductive load, such as incandescent lamps, the regulation of transformers may be within 3%, with an inductive load the drop in potential between no load and full load may increase to about 5%. If the motor load is large and fluctuating and close regulation is important, it is desirable to use separate transformers for the motors.

This article will, in a most elementary fashion, consider some of the chief factors which determine such questions as the capacity of transformer, which must be selected to take care of a given induction motor load, and some of the wiring connections commonly adopted. The proper voltage rating of transformers for three-phase and two-phase induction motors on various circuits is given in Table 1.

TABLE 1.

Delivered voltage of circuit	Single-phase transformer voltages. 110-volt motor. Primary	110-volt motor. Secondary	220-volt motor. Primary	220-volt motor. Secondary
1100	1100	122	1100	244
2200	2200	122	2200	244

For the operation of induction motors from three-phase systems, three single-phase units or one three-phase are recommended, although if desired two single-phase transformers may be used. The use of the three-phase transformers greatly reduces the space required and makes the wiring very simple;

*Abstract from *General Electric Review* July 1913.

Generated on 2024-09-30 00:19 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

while the only advantage gained in using three single-phase transformers rather than a three-phase transformer is that in the case of one transformer burning out, the other two may be used to operate the motor at reduced load.

As an approximate rule it may be said that for the larger motors the capacity of the transformers in kilowatts should equal the output of the motor in horse-power. Thus a 50-hp. motor requires 50 kw. in transformers. Small motors should be supplied with a somewhat larger transformer capacity, especially if (as is desirable) they are expected to run most of the time near full load, or even at slight overload. Transformers of less capacity than those given in Table II should not be used even when a motor is to be run at only partial load. The current taken by motors of higher voltage will be proportionately less than that given in Table III. The table gives average current values which may vary slightly from the actual values in particular cases.

TABLE II—CAPACITIES OF TRANSFORMERS FOR INDUCTION MOTORS.

Size of motor, horse-power	Kilowatt per transformer. Two single-phase transformers ...	Three single-phase transformers ...	One three-phase transformer ....
1	0.6	0.6	
2	1.5	1.0	2.0
3	2.0	1.5	3.0
5	3.0	2.0	5.0
7½	4.0	3.0	7.5
10	5.0	4.0	10.0
15	7.5	5.0	15.0
20	10.0	7.5	20.0
30	15.0	10.0	30.0
50	25.0	15.0	50.0
75	40.0	25.0	75.0
100	50.0	30.0	100.0

TABLE III—CURRENT TAKEN BY THREE-PHASE INDUCTION MOTORS AT 220 VOLTS.

Horse-power of motor	Approx. full load current	Horse-power of motor	Approx. full load current
1	3.2	20	50
2	6.0	30	75
3	9.0	50	125
5	14.0	75	185
10	27.0	100	250
15	40.0	150	370

Up to and including 5 hp., squirrel cage motors are started by simply closing the switch without any starting device. At starting, these motors require from four to five times full load current and give about 1¼ times full load torque. Motors with self-contained rotor resistance (built in sizes of 10 hp. and over) require at starting about the same current for a given torque that would be required when running. As the resistance is cut out, the torque and the current will increase practically in the same proportion until a maximum of about two or three times full load torque is reached.

CONNECTIONS

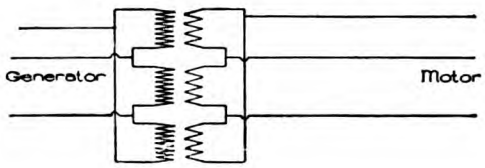
The three transformers, with their primaries connected to the generator and their secondaries to the induction motor, in a three-phase system, are shown in Fig. 1. The three primaries are connected between the three lines leading from the generator, and the three secondaries are connected to the three lines leading to the motor, in a delta connection. The connection of two transformers for an induction motor on a three-phase circuit is shown in Fig. 2. It is identical with the arrangement in Fig. 1 except that one of the transformers is left out and the other two transformers are made correspondingly larger. The copper required in any three-wire three-phase circuit for a given power and loss is 75% of that necessary with the two-wire single-phase or four-wire two-phase system having the same voltage between lines.

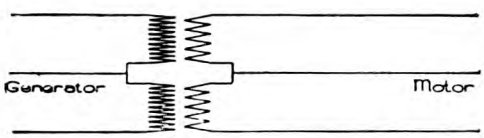
The connections of three transformers for a low tension distribution by the four-wire three-phase system are shown in Fig. 3. The three transformers have their primaries joined in delta connection, and their secondaries in Y. The three upper lines are the three main three-phase lines, and the lowest line is the common neutral. The difference of potential between the main conductors is 200 volts, while that between either of them and the neutral is 115 volts; 200-volt motors are jointed to the mains, while 115-volt lamps are connected between the mains

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

and the neutral. The neutral is similar to the neutral wire in the Edison three-wire system, and carries current only when the lamp load is unbalanced.

The potential between the main conductors should be used in calculating, and the section of the neutral wire should be made in the proportion to each of the main conductors that the lighting load is to the total load. When lights only are used, the neutral should be of the same size as the main conductors. The copper then required in a four-wire three-phase system of secondary distribution to transmit a given power at a given loss is about 33.3%, as compared with the two-wire single-phase system or a four-wire two-phase system having a voltage across lamps that is exactly the same.





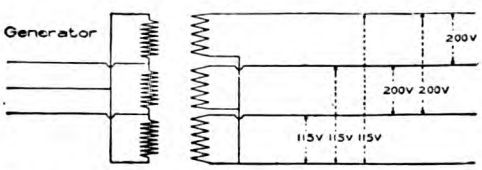


FIG. 1. THREE TRANSFORMERS FOR THREE-PHASE TRANSFORMATION.

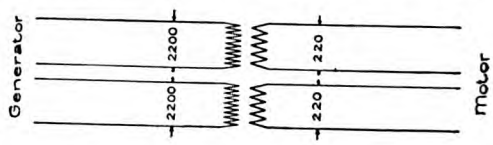
FIG. 2. TWO TRANSFORMERS FOR THREE-PHASE TRANSFORMATION.

FIG. 3. TWO TRANSFORMERS FOR FOUR-WIRE THREE-PHASE DISTRIBUTION.

The connections of two transformers for supplying motors on four-wire two-phase systems are shown in Fig. 4. This system consists practically of two separate single-phase circuits, half the power being transmitted over each circuit when the load is balanced.

Standard three-phase motors may be operated from a two-phase circuit by connecting a 9:1 transformer and a 10:1 transformer as shown in Fig. 5. While this does not give a true balanced three-phase secondary it is within 5%, and sufficiently close for motor work. With a teaser voltage of 199 instead of 208 the circuit would be balanced.

Each lead for a three-phase motor should be 58% of the cross section of each wire of the single-phase system, based on the same apparent kilowatt capacity and voltage.



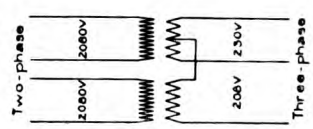


FIG. 4. TWO TRANSFORMERS FOR TWO-PHASE FOUR-WIRE TRANSFORMATION.

FIG. 5. TWO-PHASE TO THREE-PHASE TRANSFORMATION.

Before starting a motor, the secondary voltages should be tested by means of a voltmeter or one or several incandescent lamps in series, to ascertain whether the connections have been properly made, since with wrong connections excessive currents will flow and burn out the transformers, and possibly even the motor, which illustrates the importance of due care in this particular.

Australian Railways

RECENTLY the chief engineers of the different railways, together with Mr. Deane, engineer-in-chief for the Commonwealth railways, met in conference in Melbourne to further discuss adopting a uniform gauge for Australian railways. It was decided to recommend the 4-ft. 8½-in. gauge of New South Wales as the standard for

Generated on 2024-09-30 00:26 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

the lines of all the other states, and that the conversion should be undertaken as soon as possible. The estimated cost is $180,000,000. As an alternative to a uniform 4-ft. 8½-in. gage, the conference proposed, at a cost of $59,000,000, a through line from Fremantle to Brisbane on the 4-ft. 8½-in. gauge, and suggests that with this plan standardization of existing lines could be left until later. It would include a new line from Fremantle to Kalgoorlie, costing $13,500,000; a new direct line from Adelaide to Port Augusta at $5,700,000; conversion of the 5-ft. 3-in. gauge on the South Australian part of the interstate line, costing $5,000,000; conversion of the interstate part of the Victorian lines to 4-ft. 8½-in., costing $29,800,000; expenditure of $585,000 on the Moama and Deniliquin line; and construction of a new line to connect Brisbane with New South Wales, by way of Kyogle or Murwillumbah, costing $4,380,000. The conference suggested that this alternative scheme is perhaps the most attractive suggestion which could be put forward at the present time, and considers that it would meet the requirements of the immediate future, while traffic would be greatly facilitated thereby.

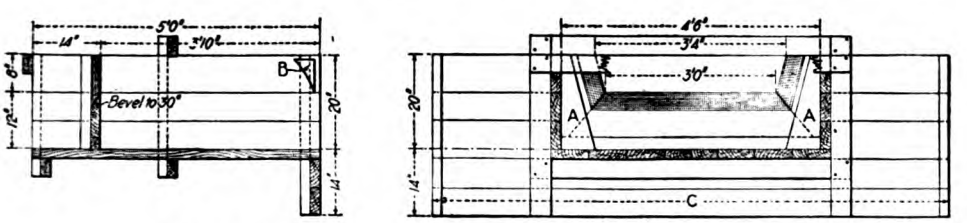
Standard Measuring Weir, Canadian Pacific Irrigation Tract*

THE weir shown in the accompanying illustrations has been approved by the commissioner of irrigation and adopted as the standard timber weir on the Canadian Pacific irrigation tract for measuring water in quantities up to 4 sec-ft. distributed from the lateral canals.

The specifications for constructing the weir stipulate that the weir-board is to be built up of pieces cut from 2 by 10-in. selected fir lumber, must have the exact dimensions indicated, and the edges must be sharp and perfectly straight, the angle of the bevel being 30° or 10 to 17. The cleats *A A* are to be cut from 2 by 8-in. lumber, and must be at least 1 in. clear of the back of the notch. No cleats are to be put on the front of the weir-board unless necessary, in which case they are to be made of 2 by 2-in. lumber beveled to triangular shape. The indicating plate *B* is to be set with its point at the exact level of the crest and the top horizontal.

The length required for the wings *C* is dependent on the location of the weir. As a rule the weirs are built as extensions to gates, in which case no wing is required. Where built as a separate structure the length *C* is to be 9 feet.

The indicating plate is cut from a No. 12 copper sheet and provided with holes for screwing it to the weir flume wall. The longest edge of the plate is cut on a curve so constructed that the length of the water line, in inches, cut off by the plate is the discharge in cubic feet per second. Heavy vertical lines are drawn and numbered on this plate at even inch distances from the vertical edge, and lighter lines are placed at the ½-in. points. For convenience in reading, heavy horizontal lines are also drawn at the 1, 2, 3, and 4 sec-ft. levels, with lighter lines between. The formula is $Q = 3.366lh^{3/2}$, where Q = discharge in cubic feet per second, l = length of bottom of weir, and h = head to still water in feet.



DETAILS OF STANDARD TIMBER WEIR FOR WATER MEASUREMENT.

*Abstract from *Engineering Record*, June 13, 1913.

Generated on 2024-09-30 00:19 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Engineers' Note Book

H. G. STOTT gives the following table, analyzing the average losses in the conversion of one pound of coal into electricity:

	Input. B.t.u.,	Input. per cent.	Losses. B.t.u.,	Losses. per cent.
1. B.t.u. per lb. coal supplied	14,150	100.0		
2. Loss in ashes			340	2.4
3. Loss in stack			3,212	22.7
4. Loss in boiler radiation and leakage			1,131	8.0
5. Returned by feed water heater	441	3.1		
6. Returned by economizer	960	6.8		
7. Loss in pipe radiation			28	0.2
8. Delivered to circulator			223	1.6
9. Delivered to feed pump			203	1.4
10. Loss in leakage and horse-power drips			152	1.1
11. Delivered to small auxiliaries			51	0.4
12. Heating			31	0.2
13. Loss in engine friction			111	0.8
14. Electrical losses			36	0.3
15. Engine radiation losses			28	0.2
16. Rejected to condenser			8,524	60.1
17. To house auxiliaries			29	0.2
Totals	15,551	109.9	14,099	99.6
Deduct losses	14,099	99.6		
Delivered to buss bars	1,452	10.3		

Thus 60% of the total heat is rejected to the condenser, 22.7% is required to maintain the draft. Most of this work is unobtainable. It is chargeable, not to the inefficiency of the mechanism, but to the inefficiency of the system. But 10.3% is utilized.

THE POWER required to drive any type of fan is a function of the volume of air handled and the pressure or vacuum obtained. The pressure is usually measured in ounces per square inch, but is often expressed in inches of water indicated by a water gauge, the measuring instrument commonly used, and which is placed at the inlet or outlet of the fan. The cubic foot is usually taken as the unit or quantity and is expressed in terms of free air or gas, that is; cubic feet of air or gas at atmospheric pressure. The unit of time generally used is the minute. The relation between pressure in ounces per square inch and the reading of the water gauge in inches is shown by the formula:

$$WG = 1.728\ P, \text{ or } P = \frac{WG}{1.728}$$

Where,

P = Pressure per square inch in ounces.

WG = Pressure in inches water gauge.

Q = Cubic feet per minute.

K = A constant.

With constant volume the power is directly proportional to the pressure; with constant pressure the power is directly proportional to the volume handled per minute. The general equation is, therefore:

$$\text{Horse-power (theoretical)} = \frac{K \times Q \times WG}{33{,}000}$$

Centrifugal fans: The above formula takes no account of the losses in the fan and therefore the actual brake horse-power required at the shaft of the fan will be greater in inverse proportion to the efficiency of the fan under consideration.

The formula under these conditions may be written as follows:

$$\text{Brake horse-power at shaft} = \frac{K \times Q \times WG}{33{,}000 \times \text{Eff}}$$

K = 5.2 for centrifugal fans.

Eff = efficiency of the fan expressed as a decimal fraction.

= 0.40 for steel plate, 0.48 for Sirocco, and 0.60 for cone type fans.

Generated on 2024-09-30 00:22 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Company Reports

Great Western Power Co. reports for June and six months, as follows:

MONTH OF JUNE, 1913

Gross operating income .....$	226,919.10
Operating expenses and taxes..	66,307.60
Net operating income.....$	160,511.50
Other income	15,302.45
Net income from all sources.$	175,813.95
Bond interest	85,108.33
Surplus for June, 1913.....$	80,705.62
Surplus for June, 1912.....	37,221.85
Increase 1913 over 1912.....$	43,483.77

SIX MONTHS ENDING JUNE 30, 1913.

Gross operating income .....$	1,317,905.35
Operating expenses and taxes.	426,356.07
Net operating income .....$	891,549.28
Other income	85,102.04
Net income from all sources.$	976,651.32
Bond interest	568,351.38
Sur. 6 mo. end. June 30, 1913.$	408,299.94
Sur. 6 mo. end. June 30, 1912.$	251,815.62
Increase 1913 over 1912 ....$	156,484.32

The Sacramento & Woodland Railroad Co. issues a statement showing results of its first year's operations. The property is a standard-gauge interurban railway, 18 miles in length, connecting Woodland and Sacramento. It is incorporated as a commercial railroad, and handles both passengers and freight. The company is capitalized for $1,000,000, and has outstanding $750,000 in 5% thirty-year bonds. The line was completed and opened for operation on July 15, 1912, and the statement for the fiscal year, therefore covers a period of eleven and one-half months only. Following is the record:

	11½ months.
Gross earnings .....$	138,547.36
Operating expense and taxes..	82,887.73
Net .....$	55,659.63
Interest	35,937.50
Surplus .....$	19,722.13

Los Angeles Gas & Electric Co., Santa Barbara Gas & Electric Co., and Long Beach Consolidated Gas Co. have reported earnings as follows:

LOS ANGELES GAS & ELECTRIC CO.

Five Months.	1913.	1912.
Gross	$2,195,025	$1,874,703
Operating	1,183,741	1,012,744
Net	$1,011,384	$ 861,959
Interest	166,791	162,013
Surplus	$ 844,593	$ 699,946

SANTA BARBARA GAS & ELECTRIC CO.

Four Months.	1913.	1912.
Gross	$90,426	$85,669
Operating	47,676	54,132
Net	$42,750	$31,537
Interest	13,480	12,971
Surplus	$29,270	$18,566

LONG BEACH CONSOLIDATED GAS CO.

Four Months.	1913.	1912.
Gross	$73,204	$55,289
Operating	48,016	36,231
Net	$25,188	$19,058
Interest	9,011	8,783
Surplus	$16,177	$10,275

The Pacific Light & Power Corporation reports as follows:

Month of May.	1913.	1912.
Gross earnings ..	$224,674.73	$198,015.26
Op. exp. & tax....	123,173.13	120,445.21
Net earnings	$101,501.60	$77,570.05
Other income	9,620.32	8,907.70
Total income	$111,121.92	86,477.75
Interest	38,540.59	42,898.44
Balance	$ 72,581.33	$43,579.31

FIVE MONTHS ENDING MAY 31, 1913.

	1913.	1912.
Gross earnings...	$1,086,749.88	$970,829.61
Op. exp. and tax..	614,405.12	580,075.52
Net earnings..	$472,074.76	$390,754.09
Other income ...	48,769.65	26,993.69
Total increase.	$520,844.41	$417,747.78
Interest	197,072.18	206,790.62
Balance	323,772.23	$210,957.16

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Book Reviews

ELECTRIC METERS,* by Cyril M. Jansky, associate professor of electrical engineering, the University of Wisconsin. Pp. 370. Ill., index. McGraw-Hill Book Co. New York. For sale by the *Mining and Scientific Press*, San Francisco. Price $2.50.

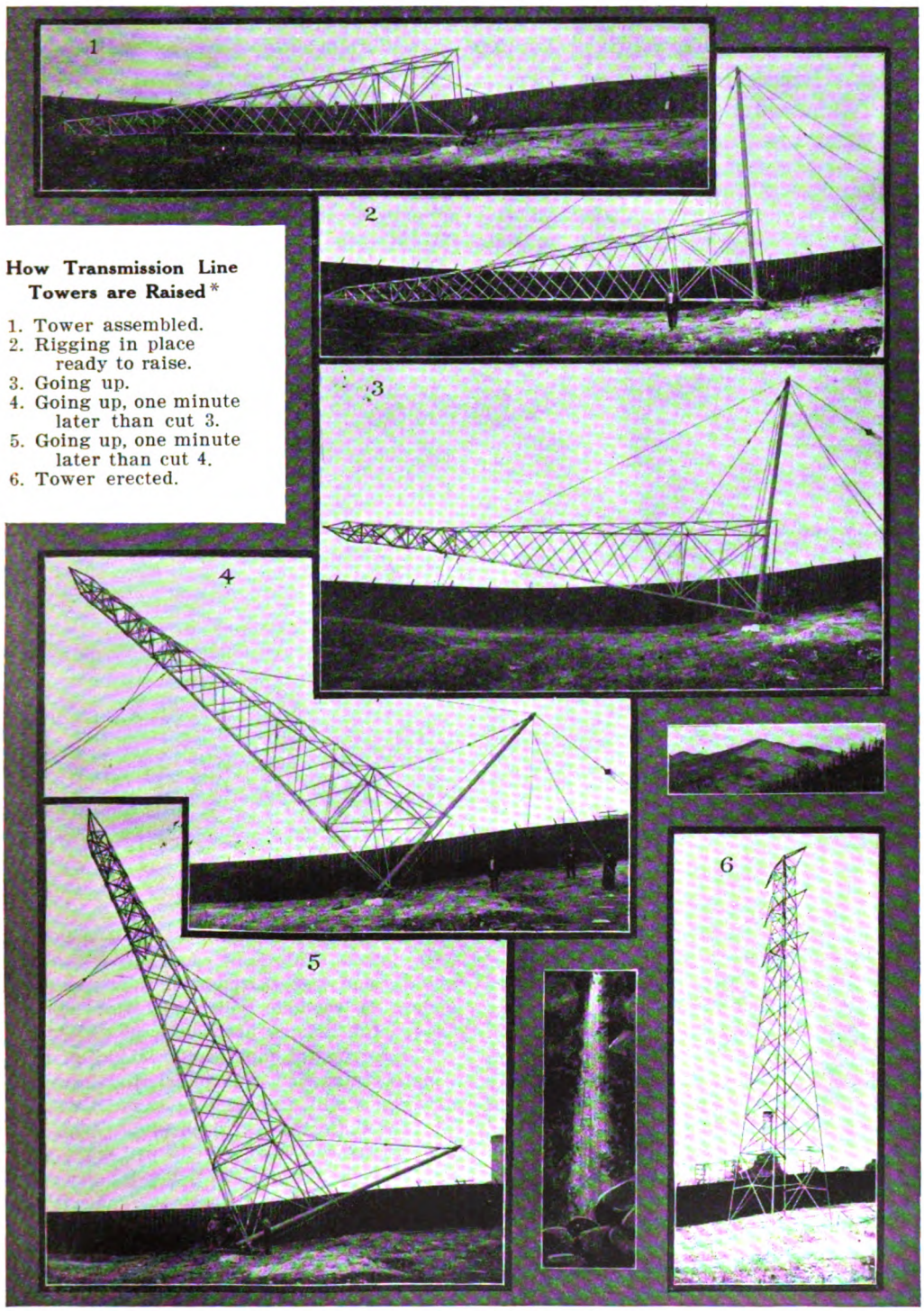
In the past information regarding electric meters has been given out by the manufacturers and for this reason has been incomplete and difficult to obtain. Mr. Jansky's book gives comprehensive information on the theory of electric meters and discusses fully their construction and operation from the standpoint of American practice. After discussing the elementary principles involved the author expounds the theory of magnetism, energy, power, etc. There are chapters on the theory of alternating currents and alternating current circuits. After describing the various simple types of volt, ampere, and watt-meters an extended discussion of the integrating watt-meter is given. The adjustment and testing of this meter are gone into exhaustively, and the effect and extent of errors in this meter are discussed at length. There are interesting chapters on power-factor, frequency meters, and synchronizing devices. Prepay meters are also discussed. This book is worthy of careful study and is not adapted for odd-time reading by the busy commercial man. It is not a hand-book, and should be used as a book of reference by the student only after it has been thoroughly mastered. The book was primarily written for the authors' course on this subject at the University of Wisconsin, but it appears to the reviewer that an appendix, containing a brief summary of the important formulae and wiring diagrams for the correct installation of meters in polyphase circuits, would be a valuable addition and of great use to the practical man who needs this information but who has neither the time nor the patience to study the whole book. Such an appendix would be invaluable to the meter man of a power company or to the engineer or machinery man who has to do with efficiency or guarantee-tests in the fields and must use meters of this kind.

*Reviewed by C. R. Sessions, Industrial Engineer, Coast Valley Gas & Electric Co., San Francisco.

CATSKILL WATER SUPPLY OF NEW YORK. By Lazarus White. John Wiley & Sons, New York. Pp. 748, Index. For sale by *Mining and Scientific Press*, San Francisco, Price $6.

In view of the fact that San Francisco is contemplating the expenditure of $75,000,000 for the development of the Hetch-Hetchy water supply project, Mr. White's work should be received with special interest in the West. The development of the Catskill water supply involved impounding over 600,000,000 gallons of water daily and its transportation to New York, a distance of 120 miles. Nearly every form of conduit known to the engineer was utilized for this vast undertaking, to say nothing of the vast quantity and variety of mechanical appliances employed in construction. The author was division engineer of the Board of Water Supply during the course of construction, and in this capacity had the opportunity to collect and compile the data that is now presented before the public in book form. It is impossible to convey through a brief review an idea of the comprehensive detail with which the subject has been treated. In the engineering bureau alone nearly 1000 men were employed in various supervisorial, executive, or designing capacities, while the list of consulting engineers includes the names of the most eminent experts in the United States. A quantity of cost data is given on all phases of the work. The general subdivisions under which the subject is treated are: History of New York Water Works; Board of Water Supply; Location of Catskill Aqueduct; Borings and Sub-Surface Investigations; Explorations for Hudson River Crossing; The Ashokan Dams and Reservoirs; Esopus Cut-and-Cover and Peak Tunnel; Rondout Pressure Tunnel and North Half Bonticou Grade Tunnel; Wallkill Pressure Tunnel; North Cut-and-Cover and One-Half Bonticou Tunnel; Wallkill Valley Cut-and-Cover Aqueduct; Moodna, Hudson, Breakneck, and Bull Hill Tunnels of the Hudson River Division; Peekskill Division Cut-and-Cover and Grade Tunnels; Steel Pipe Lines, Croton Division Cut-and-Cover Aqueduct and Grade Tunnels; Grade Tunnels, Cut-and-Cover and Pressure Aqueducts; Kensico Dam and Appurtenant Works; White Plains Division; Yonkers Pressure Tunnel and Hill View Reservoir; City Tunnel, Bronx Division and City Tunnel, Manhattan Division.

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



How Transmission Line Towers are Raised*

1. Tower assembled.
2. Rigging in place ready to raise.
3. Going up.
4. Going up, one minute later than cut 3.
5. Going up, one minute later than cut 4.
6. Tower erected.

*Published through the courtesy of the Southern California Edison Company.

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Industrial Progress

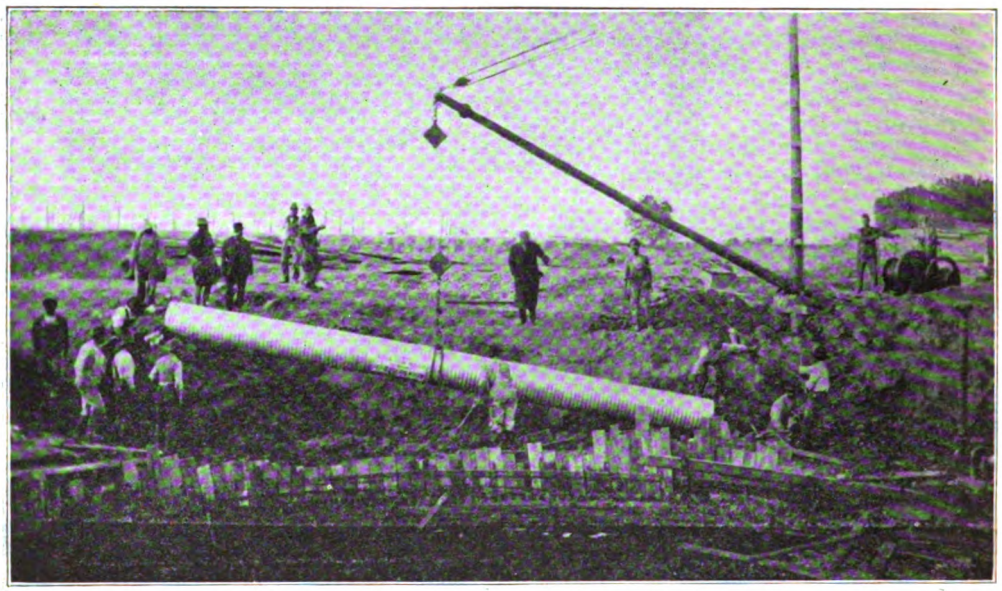
Sewer Repair by Means of Corrugated Culvert Pipe*

A quick repair of a collapsed clay pipe sewer which ordinarily carried a heavy flow of sewage, was made recently at El Paso, Texas, by means of American ingot-iron corrugated pipe. In connection with the construction of a new pipe sewer in deep cut, it became necessary to construct a sump 50 ft. in diameter and 26 ft. deep. The banks of the sump were held in place by steel sheet piling as shown in the accompanying illustration. The present main sewer, of 24-in. vitrified clay pipe, runs within 4 ft. of the sheet piling at one point. The soil traversed is such that in driving the piling the earth below the sewer was disturbed to such an extent that the pipe collapsed for a length of about 50 ft. The sewage then seeped under the piling until it filled the sump entirely and ran over the tops of the piling back onto the broken pipe line.

The illustration shows the method by which the first section of culvert pipe, 30 ft. long, was handled. The 20-ft. section was placed in the trench by hand without difficulty. An hour and a half after the replacement began the full flow of the main sewer was opened up and turned through the repaired section.

The two sections of the culvert pipe were joined by means of a band connector. A reducer 2 ft. long was used at the upstream end of the corrugated pipe to join it at that point with the clay pipe. The reducer was of suitable size to slip over the outside of the clay pipe.

The downstream end of the corrugated pipe section was inserted in the bell end of the first length of clay pipe below the original break. This joint was caulked full of oakum, and was surrounded by a concrete collar. A concrete collar was also placed around the reducer previously mentioned.



CORRUGATED CULVERT PIPE FOR EMERGENCY SEWER REPAIR AT EL PASO, TEXAS.

The corrugated pipe employed was of the usual construction, not soldered. Previous experience with this pipe in sewer work in El Paso indicates that such slight leaks as may appear will soon silt up and make the pipe practically water tight. The job was considered a success by those who had it in charge. Although this corrugated pipe is not constructed with a view to its use for sewer purposes, instances like that here described serve to show the adaptability of the material.

*Abstract from *Engineering and Contracting Journal*, June 11, 1913.

Generated on 2024-09-30 00:20 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Engineering News

Petroleum

California oil dividends for June were as follows:

Amalgamated	$1.25	$ 62,500.00
Amer. Petroleum pfd.	0.50	8,225.50
Amer. Petroleum common	0.33⅓	17,099.87
Maricopa Queen	0.005	4,960.48
Claremont	0.01	4,500.00
Dome-Pinal	0.01	4,000.00
Home (Coalinga)	0.01	10,000.00
Mount Diablo	0.0075	7,500.00
Record	0.05	10,000.00
Rice Ranch	0.05	3,000.00
S. F. & McKittrick	0.10	5,000.00
Sauer Dough	0.015	2,992.50
Section 25	0.50	20,000.00
Standard Oil of Cal.	1.25	1,125,000.00
State Consol	0.01	5,000.00
Union	0.60	184,753.60
Union Prov.	0.60	91,403.00
United Petroleum	0.60	48,450.60
West Coast pfd.	1.50	15,000.00
Western Union	0.50	5,000.00
W. K.	0.02	10,000.00
Total		$1,644,415.57

Statistics of production for June, according to the Standard Oil Co., are as follows:

	Barrels
Stocks, May 31, 1913	46,367,329
Correction due to residuum previously carried as stock of crude oil	75,770
	46,291,559
Production, June 1913	8,109,941
	54,401,500
Consumption, June 1913	8,011,831
Stocks, June 30, 1913	46,389,669
Daily average production	270,331
Daily average consumption	267,061
Daily average surplus	3,270

Field.	Rigs completed during month.	Wells. Drilling.	Producing.	Completed during month.	Aband. during month.	Production for month.
Kern River	4	8	1675	4	..	885,150
McKittrick	6	19	307	4	..	563,383
Midway	21	106	844	28	9	2,559,843
Sunset	3	33	267	8	2	490,620
Coalinga	2	60	898	7	1	1,623,551
Watsonville	..	...	5	..	..	2,250
Arroyo Grande	..	...	...	..	..	.....
Lompoc	..	3	28	..	..	97,800
Santa Maria	..	11	183	4	..	429,300
Summerland	..	...	122	..	4	5,100
Santa Paula	2	26	336	1	1	77,593
Newhall	..	1	73	..	..	8,896
Salt Lake	2	12	292	2	..	231,395
Los Angeles	..	...	400	..	..	31,240
Whittier-Coyote	2	18	146	..	..	139,966
Puente	..	...	54	..	..	2,400
Fullerton-Brea Can.	8	17	294	2	..	669,885
Lost Hills	3	17	73	4	..	291,569
Salinas Valley	..	2	...	..	..	.....
Repetto	..	...	...	..	..	.....
Totals	48	373	5997	64	17	8,109,941

Pipe-line statistics still show a shortage in production as compared with shipments from California fields. During the week ending June 21, 168,859 barrels were taken from the storage tanks in seven days runs and shipments of the Standard Oil Company.

Generated on 2024-09-30 00:26 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

The following report shows the runs by fields, shipments, and shortage:

Fields—	Barrels.
Coalinga	161,079
Newhall	10,534
Santa Maria	2,916
Midway	253,704
Whittier-Fullerton	55,804
Lost Hills	38,659
Total	522,696
Total shipments	691,555
Shortage	168,859

The United States Geological Survey gives the following total production by states for 1912:

State.	Quantity, bbl.	Value.	Price per bbl.
California	6,450,767	$ 39,213,588	$0.454
Colorado	206,052	199,661	0.973
Illinois	28,601,308	24,332,605	0.851
Indiana	970,009	885,975	0.913
Kansas	1,592,769	1,095,698	0.688
Kentucky	484,368	424,842	0.877
Louisiana	9,263,439	7,023,827	0.758
New York	874,128	1,401,880	1.604
Ohio and Michigan	8,969,007	12,085,998	1.347
Oklahoma	51,852,457	34,957,612	0.674
Pennsylvania	7,837,948	12,886,752	1.644
Texas	11,735,057	8,852,713	0.754
Utah and Wyoming	1,572,306	798,470	0.507
W. Va.	12,128,962	19,927,721	1.643
Total for 1912	222,538,604	$164,087,342	$0.737
Total for 1911	220,449,391	134,044,752	0.608

The United States Geological Survey has issued a bulletin showing the production and records of oil and gas wells in the country by fields. The record follows:

Field.	Wells completed. Oil.	Gas.	Dry.	Total.	Initial daily production (bbl.) Total.	Av. per well.
Appalachian	3,931	1016	1077	6,024	142,711	36.3
Pennsylvania and New York	1,911	239	322	2,472	6,771	3.5
Central and Southeastern Ohio	846	411	460	1,717	24,193	28.6
West Virginia	1,062	361	234	1,657	109,804	103.4
Kentucky	112	5	61	178	1,943	17.3
Lima-Indiana	547	18	75	640	8,312	15.2
Lima, Ohio	482	14	55	551	7,299	15.0
Indiana	65	4	20	89	1,083	16.7
Illinois	980	23	257	1,260	65,686	67.0
Mid-Continent	5,786	754	1189	7,729	348,442	60.2
Kansas	536	253	160	949	7,245	13.5
Oklahoma	4,712	438	843	5,993	228,886	48.6
Northern Texas	299	11	124	434	28,213	94.3
Caddo, La.	239	52	62	353	84,098	351.9
Gulf	312	....	134	546	58,602	142.2
Coastal Texas	353	....	109	462	23,082	93.7
Coastal Louisiana	59	....	25	84	25,520	432.5
California	776	....	71	847	.....	....
Colorado	15	....	13	28	.....	....
Wyoming and Utah	59	....	25	84	.....	....
Michigan	6	....	2	8	.....	....
Miscellaneous	....	....	12	12	.....	....
Total for 1912	12,512	1811	2855	17,178	.....	....
Corresponding total for 1911	9,825	1580	2363	13,768	.....	....

Bakersfield, Cal.—The new pipe-line for the General Petroleum Co. ran its first oil into the receiving tanks at Mojave on Monday, July 14. It is stated that the refinery is ready to commence operations.——A movement is under way toward the organization of an international convention of oil men in San Francisco during the exposition in 1915.

Generated on 2024-09-30 00:23 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

——The Standard Oil Co. of California paid a quarterly dividend in June of $1,125,000, which alone was greater by nearly $315,000 than the entire dividend disbursements for the California oil industry for May.——It is reported that the Sunset Monarch Oil Co. has offered to purchase the Occidental Oil Co.'s properties for $100,000.——The daily output of the General Petroleum Co. is now said to be 16,000 bbl.——The Mexican Petroleum Co. has closed two large contracts, one of which calls for the delivery of 250,000 bbl. of crude oil at Baltimore at $1.10 per bbl. and the other 1,000,000 bbl. at Galveston, Texas, at 90c. per bbl.——Negotiations are under way between the Union agency and the General Pipe Line Co. by which the latter will deliver Kern county oil to the former at San Pedro for the South American fuel trade. ——The Associated Oil Co. has recently purchased the Lorenzo, M. & S., and Columbia oil properties in the Kern river field, the total amounting to approximately 55 acres. ——The Olindo Gasoline Co. is installing on the property of the Petroleum Development Co. the first commercial plant for the extraction of gasoline from casing-head gas by the new refrigeration process. The plant will be in operation August 1, and will have a daily capacity of 100,000 cu. ft. and the yield expected will be 2500 gal.——The Asiatic Oil Co.'s tanker which brought 2,500,000 gal. of gasoline from the Dutch East Indies has again sailed for the Orient with a return cargo of 2,500,000 gal. of kerosene from the Union Oil Co.'s refinery at Oleum. ——It is said that the new refinery for the Associated Oil Co. at Avon will be in operation early in August and that by January 1, the plant will be handling 10,000 bbl. of crude oil per day.——The Amalgamated Oil Co. has increased its dividends from $1 to $1.25.——The Independent Producers Agency is building a 100-gal. capacity refinery for experimental purposes.——The San Fraterno, said to be the largest oil tank steamer in the world, arrived in London on July 16 with 15,000 tons of petroleum from Mexican fields.——It is stated that the Union Oil Co. has contracted to supply California kerosene for several years to a large marketing company in China backed by Chinese capital.——Natural gas was turned into the Redondo pipe-line by the Southern California Gas Co. on Sunday, July 6, and will be sold to consumers at about 70c. per 1000 cubic feet.

Streets and Roads

SUMMARY OF PROPOSALS FOR CONSTRUCTING SECTIONS OF STATE HIGHWAY
Opened June 30, 1913

SANTA CLARA COUNTY, DIVISION IV, ROUTE 2, SECTION C—

Estimate	$44,436.23
McGillivray Const. Co., Sacramento	40,773.60
Burns, Clark & Da Rosa Paving Co., Sacramento	42,965.00
A. Teichert & Sons, Sacramento	36,128.60
John McReynolds, San Jose	36,079.00
E. O. Burge, Sacramento	33,860.60
Blanchard Brown Co., San Francisco	54,863.00
Occidental Construction Co., Los Angeles	43,812.80
F. W. Wehner, San Jose	36,016.00
State Construction Co., San Francisco	38,589.50
John Doyle, San Jose	34,949.30

SAN LUIS OBISPO COUNTY, DIVISION V, ROUTE 2, SECTION D—

Estimate	$46,211.83
E. O. Burge, Sacramento	53,335.00
Occidental Construction Co., Los Angeles	54,969.40
Sandercock Transfer Co., San Luis Obispo	58,699.90
Mayer & Lewis, Venice	78,209.70

SAN MATEO COUNTY, DIVISION IV, ROUTE 2, SECTION A—

Estimate	$25,289.77
Burns, Clark & Da Rosa, Sacramento	31,448.00
Moreing & Fitzpatrick, Sacramento	24,338.50
J. H. Smith, San Francisco	31,379.45
Blanchard Brown Co., San Francisco	26,390.00
Occidental Construction Co., Los Angeles	23,219.50
The Daniel O'Day Co., San Francisco	27,120.50
Mahoney Bros., San Francisco	17,412.05

SANTA BARBARA COUNTY, DIVISION V, ROUTE 2, SECTION B—

Estimate	$96,550.95
Walker Const. Co., El Centro	94,713.65
Occidental Construction Co., Los Angeles	109,103.60
Asa S. Gailey, Los Angeles	122,002.95
W. W. Atkinson, Los Angeles	112,605.75
Mayer & Lewis, Venice	91,148.50

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ELDORADO COUNTY, DIVISION III, ROUTE 11, SECTION B—

Estimate	$19,372.33
Cyrus Moreing, Stockton	38,274.50
E. O. Burge, Sacramento	41,446.00
Joe Lawrence, Broderick	39,361.50
Arthur S. Lyon & Ira N. Burke, Smith's Flat	31,786.90

SAN BERNARDINO COUNTY, DIVISION VII, ROUTE 19, SEC. A and B—

Estimate	$49,266.12
Occidental Construction Co., Los Angeles	46,053.10
Louis Ferrell, Pomona	49,368.72
John R. Off Contracting Co., Pasadena	65,568.75
John Shea Co., Riverside	57,837.00
George Wiegands, La Manda Park	55,505.40
E. A. Simmons, Ontario	28,465.90
Sourwine & Cline, Ontario	54,459.78
Highway Const. Co., Redlands	44,546.00
Conner Contracting Co., Los Angeles	51,978.40
Rogers Bros. Co., Los Angeles	41,327.50
Bent & Pennebaker, Los Angeles	37,851.10
Geo. S. Benson & Sons, Los Angeles	53,656.50

Proposals opened July 21, 1913

SAN BERNARDINO COUNTY, DIVISION VII, ROUTE 9, SEC. B AND C—

Estimate	$38,246.01
Occidental Construction Co., Los Angeles	35,429.10
Highway Const. Co., Redlands	33,751.37
Walker Const. Co., El Centro	39,512.37
Sourwine & Cline, Upland	32,733.32
Geo. S. Benson & Sons, Los Angeles	42,032.50
Bent & Pennebaker, Los Angeles	34,651.00
C. J. Flower, Los Angeles	29,579.50
Geo. C. Paonessa, Los Angeles	32,153.40

San Diego, Cal.—A contract has been let to Robert Sherer & Co. of Los Angeles for constructing ten miles of roadbed for the San Diego & Arizona railroad.

Los Angeles, Cal.—Bids have been received for constructing the harbor boulevard from Palos Verdes to 5th street in San Pedro. Proposition A calls for a 40-ft. roadway, necessitating the removal of 145,000 cu. yd. The Russell-Greene-Foell Co.'s bid of $46,980 was the lowest. Proposition B calls for a roadway 130 ft. wide, necessitating the removal of 292,000 cu. yd. The lowest bid was $93,440, made by the Shattuck Edinger Company.

Bakersfield, Cal.—On July 8 the proposal to issue bonds in the sum of $2,500,000 for building county highways was approved by the voters. Approximately 330 miles of highway will be built as follows: Delano, north, 8.5 miles; Wasco-McFarland, 116; Wasco-Lost Hills, 21.3; Rio Bravo-Wasco, 18; Bakersfield-McKittrick, 37.6; McKittrick-Maricopa, 25.52; Bakersfield-Taft, 37.1; Old River-Maricopa, 28.7; Bakersfield-Oilcenter, 7.4; Oilcenter-Glennville, 30.5; Bakersfield-Sand Cut, 21.5; Sand Cut-Tehachapi, 28.2; Tehachapi-Mojave, 20.8; between Kernville and Caliente, 12.5; Weed Patch, 13.3; and Randsburg, 14.5 miles.

Oakland, Cal.—Contract for regrading and macadamizing 1⅓ miles of Dublin-Livermore boulevard was awarded to the Ransome Crummey Construction Co. for the sum of $78,691.40. The only competing bid was that of the Barber Asphalt Co. for $88,279.60.

Sacramento, Cal.—The advisory board to the Department of Engineering has let contracts for sections of the State Highway as follows: Santa Barbara county, $91,148.50, Mayer & Lewis, contractors; San Mateo county, $17,412.05, Mahoney Bros., contractors; and Santa Clara county, $33,860.60, to E. O. Burge, of Sacramento. The city commissioner of streets is contemplating repaving 8th street between L and M streets. ——A bid has been received from the Clark & Henery Construction Co. of 16.95c. per square foot for paving 11th street from R to W with 4 in. of water-bound macadam covered with 2 in. of asphalt.

Colusa, Cal.—The Clark & Henery Construction Co. has commenced work upon the cement walks and asphalt streets on Market street. Ten city blocks in all are to be repaved.

Oroville, Cal.—The Board of Supervisors has announced that a new road will be constructed from the Garden ranch to North Honcut.

Downieville, Cal.—The Supervisors have appropriated $5000 toward building a road on the Sierra county side of the Middle Yuba river. A. D. Foote, of Grass Valley, has the contract for building the road on the Nevada county side.

Spokane, Wash.—The city council has awarded a contract to the Barber Asphalt Co. at a price of $23,975 for paving Market

Generated on 2024-09-30 00:22 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

street from South avenue to Sanson avenue. Standard bitulithic paving having a 2-in. top dressing and a 4-in. portland cement concrete base will be used. The county commissioners have decided to construct the Trent road viaduct at a cost of $20,000.——A mile of macadam or asphalt road on the Lincoln county line to connect the Sunset boulevard is to be built. Plans have been prepared for the proposed connection between the west end of the new Latah bridge and Sunset boulevard at F street and also the north end of the North Monroe street paving via Monroe street hill and Garland avenue. The work to be done includes roadways, curbing, and sidewalks, using Spokane bituminous No. 2 on a portland cement concrete base. Z. E. Hayden is commissioner of public works and Morton Macartney is city engineer.——Specifications have been adopted for paving Market street. The lowest estimate was for bitu-mass paving with a concrete base at a cost of $20,462.——The following bids were received for 8 miles of paved highway on Moran prairie: Spokane Asphalt & Macadam Paving Co., $84,000, for asphalt macadam; one course concrete, $130,000; two course concrete, $126,000; bitucrete on macadam, $119,000; water-bound macadam, $77,000. C. M. Payne bid $114,393 on warrenite. Warren Bros. bid $172,663.09 on the same, and Spokane Bitu-mass Paving Co. bid $133,848 on bitu-mass. Caughren & Woldson bid as follows: one course concrete, $135,970.52; two course concrete, $133,690.52; dolarway, $143,570.52; warrenite, $173,970.52; asphalt macadam, $113,160.52; water-bound macadam, $86,570.52. McHugh & Chadbourne bid $147,000 for bitucrete on concrete and $144,000 for bitucrete on macadam. J. W. Strack is county engineer and C. M. McClung is chief deputy.——The State Highway Board has announced the selection of the Spangle route for the Inland Empire highway in Spokane; $199,555 is available for the construction work on this highway from Spokane south. In addition nearly $80,000 is available for work either north or south from Colfax. W. J. Roberts is highway commissioner.

North Yakima, Wash.—Work of surveying the first section for the Cascade Scenic highway is under way.

Pullman, Wash.—An extensive program of road and street building is being considered. The Warren Construction Co. has received a contract for paving 9152 sq. yd. of street with bitulithic paving for the sum of $20,781.

Wenatchee, Wash.—The Chelan county commissioners have placed a contract for the construction of a highway at Entiat valley with J. J. McNerney for the sum of $18,198.95.

Boise, Idaho.—The Idaho State Highway Commission will contribute to the cost of constructing the Northern Idaho link in the National Highway. F. P. King is state engineer.

Peck, Idaho.—A new road is to be built down Central ridge to Peck; $8000 is to be expended for this purpose.

Salt Lake City, Utah.—The county commissioners have decided to proceed with the construction of the county highway from Summit county line down Parley's canyon and across the valley to the Tooele county line, around the southern end of Salt Lake. Approximately $12,000 is available for doing this work. B. H. Burrell is engineer in charge of planning the entire county road system.——The city commission has decided to pave 11th street east from 12th to 13th south streets with Utah rock asphalt. An experimental road of 1¼ miles long on State street is to be laid with five different combinations of Utah rock asphalt in order to test its value as a road material; $2000 is to be expended for doing this work.——The city commission has awarded a contract to Jos. Mellen for curbing and gutter extension No. 20 at a price of $127,566.97. The other bids were as follows: P. J. Moran, $128,204.87; G. A. Heman, $137,165.66; A. A. Clark company, $147,986.94; McKay & Reed, $169,175.84. The engineer's estimate on the work was $170,000.

Ogden, Utah.—The city commissioners have decided to open Market street through block 24 from Grant avenue to Lincoln avenue between 24th and 25th streets. The street will be 60 ft. wide and the total estimated cost of improvement is $28,000. The Mayor has recommended the paving of 25th street between Washington and Harrison avenues; 8 blocks are included in this project.

Power, Gas, and Electricity

San Francisco.—Recent actions taken by the California Railroad Commission are as follows:——Authority has been granted to the San Diego Consolidated Gas & Electric

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Co. to issue $639,000 of 30-year bonds to provide funds for building additions to the company's plant in San Diego.——Authority has been granted to the Great Western Power Co. to operate under franchises previously given in Contra Costa county, especially in the vicinity of Antioch.——Authority has been granted to the Pacific Gas & Electric Co. to purchase ditches and water rights from the United Water & Power Co. for use in the development of the Bear creek hydro-electric projects in Placer county. The company has also been authorized to construct additional power plants and an extension of the Bear river canal and transmission line from Nicolaus near Sacramento; $2,400,000 is to be spent in this work and the total estimated capacity is to be 35,000 kw.——Permission has been denied to the Mt. Jackson Water Power Co. to issue $11,000 in bonds.——The San Joaquin Light & Power Corporation has been authorized to issue $1,776,000 in bonds to provide funds for completing the company's power-house, sub-stations, and transmission lines in connection with its new hydro-electric power project.——The Beaumont Gas & Power Co. has been authorized to issue a mortgage note in the sum of $5000 for the purpose of liquidating existing indebtedness.——Permission has been granted to W. L. Childers to lease the Crescent City water works of the Mountain Power Co. to Crescent City.——The Santa Barbara Gas & Electric Co. has applied for authority to issue $100,000 in bonds to provide funds for extending and improving its system.——The Great Western Power Co. and the Pacific Gas & Electric Co. have discontinued charging flat rates on electricity and in future all new customers will be furnished a meter and charged for the actual amount of power used.

Los Angeles, Cal.—The Secretary of Agriculture has granted rights to the Pacific Light & Power Co. of Los Angeles to operate power plants in the Sierra national forest. The transmission line will be 240 miles in length and voltage 150,000. This includes the Big Creek Basin reservoir with a capacity of 103,000 acre feet; the construction of three dams, and power-houses No. 1 to 4 operating under heads of 2091, 1915, 1440, and 478 respectively.——A reservoir of 25,000 acre-feet capacity is to be constructed in the San Joaquin river and three steel tower transmission lines to Los Angeles are to be built.——The city council has ordered that underground conduits are to be installed in 8th street between Main street and Central avenue. All work must be done within 40 days from the date that the ordinance goes into effect and the lines must all be under ground within a year.

Folsom, Cal.—The local plant of the Pacific Gas & Electric Co. will close down for the summer months on account of lack of water.

Thrall, Cal.—The President has permitted patents to issue to the state of California on a strip of land near Thrall, 160 acres in extent, in the interest of the California-Oregon Power Co. Plans are under way for a great increase in power output.

Quincy, Cal.—The local electric light plant owned by F. G. Gansmer was destroyed on July 7 by fire. The loss is estimated at $12,000. New machinery is to be installed at once.

Reno, Nevada.—The Truckee Gas & Electric Co. has issued a statement that on account of shortage of water in Lake Tahoe the company may be compelled to shut down its plant during the summer season.

Spokane, Wash.—The Washington Water & Power Co. has completed the purchase of properties of the Idaho-Washington Light & Water Co. with headquarters at Moscow, Idaho. The properties taken over include the electric light and power companies at Tekoa, Farmington, Pullman, Palouse, Garfield, Uniontown, Oakesdale, Genesee, Colton, Troy, Moscow, and St. Maries. D. L. Huntington is president of the Washington Water & Power Co. Many improvements in equipment and service are contemplated.

Davenport, Wash.—The Washington Electric Power Co. has been granted right of way for the high-tension transmission lines to convey current to Creston, Wilbur, Almira, Hartline, Coulee City, and Euphrata by way of Davenport.

Wilbur, Wash.—The Wilbur Electric Co. has sold its entire plant to the Washington Water & Power Company.

Elgin, Ore.—The Eastern Oregon Co-operative Telephone Association has voted to issue bonds for $30,000 to complete its lines through Union canyon.

Rossland, B. C.—The West Kootenai Power Co. has arranged for the installation of an additional unit of 8000 hp. at Bonnington. The company now has 24,000 hp. in operation.

Ogden, Utah.—The city commissioners

Generated on 2024-09-30 00:27 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

have granted a franchise to the General Service Corporation for the construction of the new gas plant and distributing system. Actual construction work is to commence on August 1.

Railways

Los Angeles.—The Pacific Electric Railroad Co., which is now constructing the municipal street railroad from Los Angeles to San Pedro, will operate it under a lease for seven years.

San Francisco.—The Sacramento Valley Electric Railroad Co. has applied to the Railroad Commission to extend the time of its authorization to issue stock from August 1, 1913, to August 1, 1914.——The Board of Supervisors has set August 26 as the date for holding a special election to authorize a bonded indebtedness of $3,500,000 for an extension of the municipal railroad system. ——The Clear Lake Railroad Co. has applied to the Railroad Commission for authority to issue stock and bonds for the purpose of raising $396,300 to build a railroad from Hopland, Mendocino county, to Lakeport in Lake county. The company has an authorized capitalization of $500,000 and an authorized bond issue of $400,000. The railroad will be 25 miles long. L. H. Boggs is president of the company.——The San Diego & Southeastern Railroad Co. has been authorized by the Railroad Commission to issue bonds in the sum of $343,000 to provide funds for the purchase of locomotives, flat cars, and other betterments.

Tulare, Cal.—The Big Four Electric Co. has applied to the Railroad Commission for permission to increase its capital stock to $5,000,000. It is proposed to extend the line to Dinuba and Hanford. Branches are now under construction to Woodville, Poplar, and Porterville. Frank Avery is general manager.

San Rafael, Cal.—S. J. Norton of this city is promoting a new electric railroad to be known as the San Rafael & San Anselmo Valley Railroad Co. The company is to be capitalized for $100,000 and will be six miles long and run parallel to the Northwestern Pacific line from San Rafael to Fairfax. Storage battery cars are to be used.

Portland, Ore.—The Oregon-Washington R. & N. Co. is contemplating many improvements and additions during the coming year. These include the completion of the Oregon & Eastern line to Riverside, 80 miles west of Vale, and the new air line from Snake river to Spokane. Surveys are now under way for the Fossil and Pilot Rock extensions and also for the new line from Centralia to Willapa harbor. The shops at Albina and La Grande are to be improved. The freight houses, team tracks, yards, and bridge over the city waterway are to be constructed at Tacoma.

Spokane, Wash.—Plans have been submitted by the Spokane-Portland & Seattle railroad to the city engineer for the construction of four elevated street crossings; $70,000 to $80,000 will be spent for this work. A. N. Lupfer is chief engineer.

Seattle, Wash.—The public utilities committee of the city council has voted to recommend that an offer of $1,250,000 be made for the entire property of the Seattle, Renton & Southern railway.

Salt Lake City, Utah.—The Star Coal Co. of Salt Lake has let a contract to L. R. Watrus Construction Co. for the construction of a railroad at a cost of $500,000. The road will extend between the company's coal mine in Spring canyon, Carbon county, to Storrs, a distance of about 5 miles. The company will also expend $200,000 for mining machinery at once. The following are the officers of the company: F. A. Sweet, president; L. F. Rains, vice-president and general manager; George Payne, secretary and treasurer. The offices of the company will be in the Kearns building.

Butte, Mont.—Charters were filed for two corporations under Montana laws, the Boston and Montana Development Co., capital $15,000,000, and the Butte, Wisdom & Pacific railway, $3,000,000. The development company will finance the railroad company which will construct a railroad from Butte into the Big Hole basin country of Montana, terminating at Wisdom and Jackson. Lieutenant-Governor W. R. Allen is president of both companies.

Miscellaneous Engineering Construction

Los Angeles.—The wharf in Mormon Island channel has been completed and is ready to turn over to the city.——According to the monthly report of the Harbor Improvement Bureau a total of $2,600,025.83 was expended for various harbor improvements in 1912.

Yuma, Arizona.—Plans have been com-

Generated on 2024-09-30 00:21 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

pleted for the construction of a bridge to span the Colorado river at Yuma.

Long Beach, Cal.—High tides have washed out 500 ft. of cement work and 200 ft. of walk in the west bulkhead and walk from the Hotel Virginia to the east jetty. The damage is estimated to be $5000.

San Jose, Cal.—The city council has decided to expend $50,000 for a septic tank and a main outfall sewer.——The Spring Valley Water Co. is said to have commenced work on the construction of a dam on Calaveras creek in Alameda county for the purpose of providing a reservoir for water storage purposes.

San Francisco.—Construction work on the Stockton street tunnel has commenced. Jacobson & Bade are the contractors. The cost of the work when completed will be $337,000.

Sacramento, Cal.—A bridge is to be built across the American river at a cost of $82,000.

Oroville, Cal.—The supervisors have made plans for the construction of six new bridges in the vicinity of Chico.——An Eastwood multiple arch dam is to be built on Marsh creek to impound water for irrigating 8000 acres for Los Verjels Land & Water Co. near Bangor. T. Z. McGillicuddy of San Francisco is carrying on the project with John S. Eastwood as consulting engineer.

Quincy, Cal.—The Board of Supervisors has awarded a contract for constructing a bridge across Slate creek to the Dozier Construction Co. of Sacramento at a price of $3500. The bridge will be 100 ft. span and constructed of concrete.

Marysville, Cal.—The Board of Supervisors is considering the construction of a new bridge across the Yuba river at the foot of D street. It is estimated that the cost will be $200,000.

Spokane, Wash.—The Oregon-Washington R. & N. Co. is contemplating a dry fill of 1,000,000 cu. yd. as part of its project for the construction of new freight terminals near the north end of the Monroe street bridge. J. B. Isaacs is resident engineer. ——It is proposed to build a concrete retaining wall to hold the fill at the south end of the Monroe street bridge. J. E. Hayden is commissioner of public works and A. N. Lupfer is chief engineer of the Inland-Empire system.——Plans are also under consideration for the construction of four permanent bridges.

Salt Lake City, Utah.—The following is a partial summary of some of the larger sums to be spent this year for industrial improvements in Utah:

Denver & Rio Grande	$ 3,500,000
Utah Railway Co.	2,000,000
S. L. & U. Electric	1,500,000
Ogden-Logan Electric	1,500,000
Irrigation projects	2,000,000
Oregon Short Line	1,000,000
U. L. & Ry. Co.	1,500,000
Mountain States Tel. & Tel. Co.	325,000
Utah Gas & Coke Co.	300,000
Increased bank capitalization in Salt Lake City	864,000
Dairying investments	425,000
Smaller industries (estimated)	4,000,000
S. L. & Ogden Electric	400,000
Total	$19,314,000

The J. P. Fowler Mfg. Co. will install new machine shops at a cost of $12,000.——The county commissioners are considering the installation of a garbage incinerating plant. ——An appropriation has been made providing $11,000 for lowering and replacing the water mains in 7th avenue.

North Yakima, Wash.—The proposed issue of $240,000 in bonds for the construction of a new sewer system and sewage disposal plant has been defeated by the voters.

Kellogg, Idaho.—Bids are being received for the construction of a new sewer system at a cost of $30,000. Robert L. Sterling is city engineer.

Irrigation and Water Supply

San Francisco.—The Railroad Commission has decided that the Glendale Consolidated Water Co. and the Miradero Water Co. must install water meters for all service connections.——The Board of Public Works will install an additional high-pressure pipe-line in the Fort Mason reservation.

Sacramento, Cal.—The following bids have been received for the 450-hp. pumping engine to be installed at the city water works: C. F. Gorman & Co., electric engine, $11,500; steam engine, $17,000. David Rogers & Co., electric engines, $10,950 and $11,210. United Iron Works, steam engine, $11,500; electric engine, $10,800. C. C. Moore Co., steam turbine, $17,200; steam engines, $16,500, $15,107, $14,305; electric engines, $6973 and $7500.

Woodland, Cal.—The Yolo Water & Power Co. has stated that were its irrigation ditches not lined with concrete, the Capay-

Generated on 2024-09-30 00:26 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Winters and Adams ditches would now be without water and stop irrigation operations until the commencement of the rainy season. ——The Superior Court of Yolo county has decided that the district irrigation bonds are legal for payment of obligations for the district.

Chico, Cal.—The Ben Crouch and Phelan ranches and Parrot grant near Chico, including 10,000 acres in all, will be placed under irrigation when the dam across Butte creek is completed. Contract for the dam has been let to the Chico Construction Company.

Reno, Nev.—It has been announced that the United States Reclamation Service will build a dam in Mason valley to form a reservoir for supplying water for irrigation purposes.

North Yakima, Wash.—Plans have been adopted to make preliminary surveys for a 100,000 acre irrigation project in Palouse county. The expense is to be borne jointly by the state and the federal government; $20,000 is to be expended for this work.

Spokane, Wash.—Laterals and water mains are to be installed on East Sprague avenue from Lacy street to the east city limits.

Quincy, Wash.—The voters have ratified the issuance of $200,000 in bonds for carrying on the Quincy irrigation project.

Volmer, Idaho.—Contract has been let to Sandberg & Beaman for drilling an artesian well; $10,000 is to be expended for the construction of a new water system.

Pendleton, Ore.—The American National Bank has taken the entire issue of $200,000 in bonds for the construction of the new Thorne Hollow water system. The mains are to be constructed of concrete.

Ogden, Utah.—The city commissioners have passed a resolution to call for a special election for the purpose of voting $75,000 in bonds to provide funds for a dam on the south fork of the Ogden river to impound water for the municipal water works system of the city.——A contract has been awarded by the city commissioners to the Wheelright Construction Co. amounting to $872.30 for placing an emergency pipe-line to connect the city main with that of the Utah Light & Railway Company.

Salt Lake City, Utah.—A series of tests conducted by H. K. Burton, city water engineer, has shown that sufficient water flows into the lakes at the head of Big Cottonwood canyon to justify building the proposed dams as originally specified. Bids are being advertised for the construction of these dams, and contract will be let early in August.

Payson, Utah.—The city council has awarded a contract for the construction of a new city water works system to the Wheelright Construction Co. of Ogden at a price of $52,000.

Panama-Pacific Exposition

Sixty-five thousand square feet of floor space has been set aside in the Palace of Transportation for the marine display.——The social economy exhibit will be greater than that at any other exposition. The space applied for so far exceeds the total allotment for this department.——The National Cash Register Co. has applied for a space of 6000 sq. ft., the National Museum of Safety for 15,000 sq. ft., and the Philippines have been granted space of 12,000 ft.——The Director of Works has reported that 270 head of stock are engaged in grading the exposition site; the construction of the freight slip and its bridge is nearly completed.——An average of 70,000 ft. of lumber per day was erected in place in the machinery building during the month of June.——The erection of the frame for the Palace of Education was started on May 10, and about 900,000 ft. of lumber had been placed up to July 18, making a total average of 30,000 ft.——A large portion of floor has been laid and about 300,000 ft. of lumber has been placed in the floor for the Palace of Agriculture. Three fire stations will soon be built. Plans for the electrical installations in the various buildings are well under way.

Discussion

Diesel Engines in the United States

The Editor:

Sir—A commercial paragraph in your April 1913 issue, page 342, announces the installation by the New London Ship & Engine Co., of Groton, Connecticut, of the first horizontal Diesel engine in the United States. This statement is undoubtedly based on misinformation, as, to the best of my knowledge, the first horizontal Diesel engine installed in the United States is a 300-hp. 2-cylinder Koerting engine, made by Gebrueder Koerting Aktiengesellschaft, Koertingsdorf, Hanover, Germany, for the Bosch Mag-

Generated on 2024-09-30 00:17 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

neto Works at Springfield, Massachusetts. This engine has been in operation for more than a year, belted to a generator. From figures supplied by the Bosch Magneto Co., its average fuel consumption per kilowatt-hour at the switchboard under actual operating conditions has been as follows: 0.83 lb. fuel oil at half load, or 16,400 B.t.u. per kilowatt-hour; 0.69 lb. fuel oil at three-quarters load, or 13,600 B.t.u.; and 0.67 lb. fuel oil at full load, or 13,300 B.t.u. per kilowatt-hour. These consumptions are well within the manufacturer's guarantee. Actual average fuel consumption of the engine, furnishing the varying factory load, is reported not to have exceeded 0.73 lb. fuel oil per kilowatt-hour at the switchboard. As this is a belt-driven alternating-current generator set, the above fuel consumptions show a very high engine efficiency. As the Koerting engine burns successfully residues containing as much as 50% asphaltum, the above remarks may be of interest to your local readers.

H. HAAS.

San Francisco, July 30.

Personal

E. H. FIERO and W. A. RICHARDS have been appointed assistant city engineers at Salt Lake City.

M. M. O'SHAUGHNESSY, city engineer of San Francisco, has returned from Washington, D. C.

D. C. JACKLING, formerly of Salt Lake City, will establish a permanent residence in San Francisco.

ABBOTT GREEN has been retained by the Board of Supervisors of Modoc county to make a soil survey.

W. G. NEWSOM, chief engineer of the West Oakland shops of the Southern Pacific Co., is in Salt Lake City.

T. J. WYCHE, chief engineer for the Western Pacific Railroad, has been in San Jose on an inspection trip.

H. G. TOLLEY, of Sydney, Australia, has been investigating irrigation methods in the vicinity of Salt Lake City.

R. E. MAYNARD has been appointed general manager of the General Pipe Line Co., with headquarters at Los Angeles.

W. S. FARLEY, formerly city engineer of Richmond, California, is preparing a report on the new Richmond water district.

GEORGE W. MANNING has been appointed superintendent of railway service for the Utah Light & Railway Co. of Salt Lake City.

F. B. KING, state engineer of Idaho, has been inspecting the proposed national highway through Shoshone and Kootenai counties.

HUGH WILSON, service engineer for the California State Railroad Commission, has been in Venice, California, on official business.

ALBERT GIVAN, city engineer at Sacramento, has been in San Francisco investigating the high-pressure water system for fire protection.

PAUL M. PAINE, superintendent of the Honolulu Oil Co. at Fellows, has returned to his duties after a month's leave of absence.

KIRK BRYAN, of the U. S. Geological Survey, is to make a geological investigation of the property of the Solano Irrigated Farms.

W. J. ROBERTS, State Highway Commissioner of Washington, has been on an inspection trip over state roads in Chelan county.

CHARLES KNAPP, chief engineer of the Pullman Palace Car Co., has been inspecting the Company's plant at Richmond, California.

B. K. STROUD has resigned his position as field superintendent for the Universal Oil Co. at Wasco and will engage in general practice.

R. BUDD, chief engineer of the Great Northern Railway at St. Paul, has been in Spokane, Washington, on a general inspection trip.

MORTON MACARTNEY, city engineer of Spokane, has been inspecting the Spokane river to determine the injurious effects of sewage at low water.

H. W. THOMPSON has been appointed superintendent of refineries, and FELIX CHAPPELLET has been appointed general superintendent of the General Petroleum Company.

WALTER S. KEITH, formerly superintendent of the Helester Gold Mining Co.'s property at Towle, California, is now with the Henry Cowell Lime & Cement Co., at its Portland, Oregon, branch.

D. C. WRIGHTER, city engineer at Lewiston, Idaho, is one of the committee to inspect the bridge between Lewiston and Clarkston, which is to be purchased jointly by the states of Idaho and Washington.

Generated on 2024-09-30 00:18 GMT / https://hdl.handle.net/2027/uiug.30112007837898
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN